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E09	17.50	35.00
E10	20.00	40.00
E11	22.50	45.00
E12	25.00	50.00
E13	28.00	56.00
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For related information see also *Astronautics*.

01 AERONAUTICS (GENERAL)

02 AERODYNAMICS

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VOLUME 15 NUMBER 2 / JANUARY 23, 1977

TABLE OF CONTENTS

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

01 AERONAUTICS (GENERAL) 141

02 AERODYNAMICS 141

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

03 AIR TRANSPORTATION AND SAFETY 145

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 145

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command and Tracking* and *32 Communications*.

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 146

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

06 AIRCRAFT INSTRUMENTATION 148

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

07 AIRCRAFT PROPULSION AND POWER 149

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

08 AIRCRAFT STABILITY AND CONTROL 151

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

09 RESEARCH AND SUPPORT FACILITIES (AIR) 152

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*.

12 ASTRONAUTICS (GENERAL) 153

For extraterrestrial exploration see *91 Lunar and Planetary Exploration*.

13 ASTRODYNAMICS 153

Includes powered and free-flight trajectories; and orbit and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) 154

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air)*.

15 LAUNCH VEHICLES AND SPACE VEHICLES 154

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

16 SPACE TRANSPORTATION 155

Includes passenger and cargo space transportation, e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING 156

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 156

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

19 SPACECRAFT INSTRUMENTATION 157
For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

20 SPACECRAFT PROPULSION AND POWER 157
Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.
For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

23 CHEMISTRY AND MATERIALS (GENERAL) 158
Includes biochemistry and organic chemistry.

24 COMPOSITE MATERIALS 159
Includes laminates.

25 INORGANIC AND PHYSICAL CHEMISTRY 161
Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.
For related information see also *77 Thermodynamics and Statistical Physics*.

26 METALLIC MATERIALS 163
Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 167
Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

28 PROPELLANTS AND FUELS 169
Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.
For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion*.

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.
For related information see also *Physics*.

31 ENGINEERING (GENERAL) 172
Includes vacuum technology; control engineering; display engineering; and cryogenics.

32 COMMUNICATIONS 178
Includes land and global communications; communications theory; and optical communications.
For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

33 ELECTRONICS AND ELECTRICAL ENGINEERING 183
Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.
For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

34 FLUID MECHANICS AND HEAT TRANSFER 188
Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.
For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

35 INSTRUMENTATION AND PHOTOGRAPHY 193
Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.
For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation*.

36 LASERS AND MASERS 198
Includes parametric amplifiers.

37 MECHANICAL ENGINEERING 199
Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 202
Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 203
Includes structural element design and weight analysis; fatigue; and thermal stress.
For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.
For related information see also *Space Sciences*.

42 GEOSCIENCES (GENERAL) N.A.

43 EARTH RESOURCES 211
Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

44 ENERGY PRODUCTION AND CONVERSION 216
Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.
For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation*.

45 ENVIRONMENT POLLUTION 221
Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

46 GEOPHYSICS 227
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.
For space radiation see *93 Space Radiation*.

47 METEOROLOGY AND CLIMATOLOGY 230
Includes weather forecasting and modification.

48 OCEANOGRAPHY N.A.
Includes biological, dynamic and physical oceanography; and marine resources.

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.

51 LIFE SCIENCES (GENERAL) 231
Includes genetics.

52 AEROSPACE MEDICINE 233
Includes physiological factors; biological effects of radiation; and weightlessness.

53 BEHAVIORAL SCIENCES 235
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT 236
Includes human engineering; biotechnology; and space suits and protective clothing.

55 PLANETARY BIOLOGY N.A.
Includes exobiology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) N.A.

60 COMPUTER OPERATIONS AND HARDWARE 239
Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering*.

61 COMPUTER PROGRAMMING AND SOFTWARE 241
Includes computer programs, routines, and algorithms.

62 COMPUTER SYSTEMS 246
Includes computer networks.

63 CYBERNETICS 247
Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support*.

64 NUMERICAL ANALYSIS 248
Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY 250
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS 253
Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS 253
Includes topology and number theory.

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.
For related information see also *Engineering*.

70 PHYSICS (GENERAL) 254
For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar Physics*.

71 ACOUSTICS 254
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 256
Includes atomic structure and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 258
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 259
Includes light phenomena.

75 PLASMA PHYSICS 261
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 262
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 265
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 265
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 266
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS 267
Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE 268
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 268
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 271
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 272
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 273
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

92 SOLAR PHYSICS 273
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 274
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

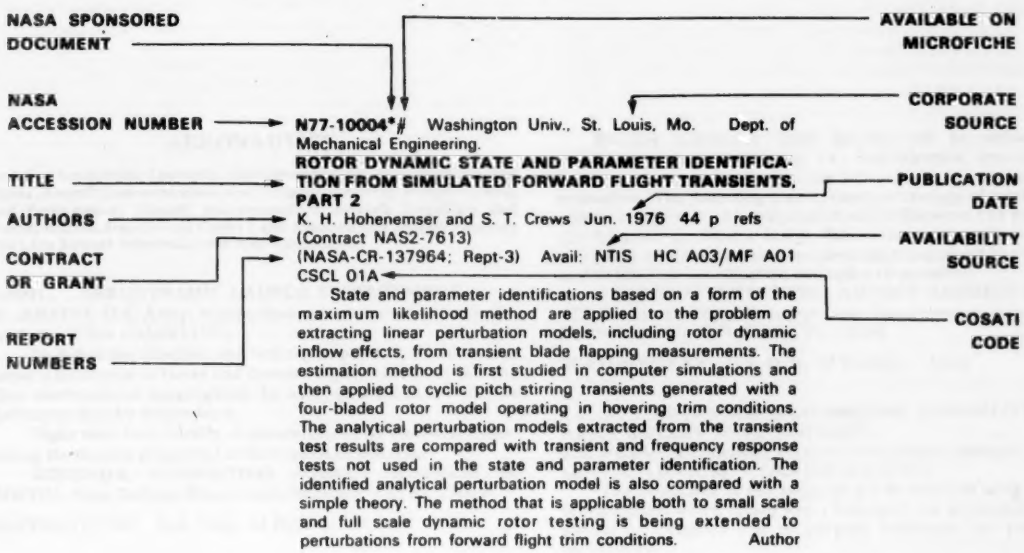
GENERAL

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

SUBJECT INDEX I-1
PERSONAL AUTHOR INDEX I-43
CORPORATE SOURCE INDEX I-49
CONTRACT NUMBER INDEX I-61
REPORT/ACCESSION NUMBER INDEX I-65

TYPICAL CITATION AND ABSTRACT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N77-10004*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.
TITLE
ROTOR DYNAMIC STATE AND PARAMETER IDENTIFICATION FROM SIMULATED FORWARD FLIGHT TRANSIENTS, PART 2
PUBLICATION DATE
AUTHORS
K. H. Hohenemser and S. T. Crews Jun. 1976 44 p refs
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REPORT NUMBERS
State and parameter identifications based on a form of the maximum likelihood method are applied to the problem of extracting linear perturbation models, including rotor dynamic inflow effects, from transient blade flapping measurements. The estimation method is first studied in computer simulations and then applied to cyclic pitch stirring transients generated with a four-bladed rotor model operating in hovering trim conditions. The analytical perturbation models extracted from the transient test results are compared with transient and frequency response tests not used in the state and parameter identification. The identified analytical perturbation model is also compared with a simple theory. The method that is applicable both to small scale and full scale dynamic rotor testing is being extended to perturbations from forward flight trim conditions. Author

ON-GOING RESEARCH PROJECTS

This is a listing of research projects - not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, AERODYNAMIC LAUNCH ENVIRONMENT

B. JENKINS, U.S. Army, Missile Systems Laboratory, *Huntsville, Alabama* 35809 (DA0E1109)

To define the direction and velocity at points in the airstream about a helicopter in hover and forward-flight sufficiently that the flow environment encountered by missiles launched from the helicopter may be determined.

Flight tests for a variety of situations will be conducted measuring the desired properties in the regions of interest.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MICOM, Aero-Ballistic Directorate, Redstone AR, Al. 35809

SUPPORTED BY U.S. Dept. of Defense - Army

1.0002, IMPROVED SURGE MARGIN CENTRIFUGAL COMPRESSOR

R. CLARKE, Signal Companies Incorporated, *Phoenix, Arizona* 85034 (DA0D3999; DAAJ02-75-C-0033)

The objective is to investigate experimentally the factors critical to centrifugal compressor flow range, surge, and efficiency flow characteristics, and subsequently, to demonstrate a single-stage, high- pressure-ration centrifugal compressor having peak performance on or near a projected engine operating line. Achievement will result in approximately a four-point improvement over current operating line efficiency with a predicted 6-8 percent reduction in fuel consumption and its attendant potential for increased range and/or payload for future Army helicopters.

Design a baseline 10-1 pressure ratio compressor having a geometry favorable to broad flow range and a number of modifications thereof varying geometrical/aero factors critical to flow range and efficiency. Fabricate, test and analyze data to formulate design correlations for the critical factors. Use the correlations to design, fabricate and test an optimum compressor stage.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0003, COMBUSTOR DESIGN CRITERIA, ARMY AIRCRAFT

K.M. JOHANSEN, Signal Companies Incorporated, *Phoenix, Arizona* 85034 (DA0D4007; DAAJ02-75-C-0044)

Combustors have typically required more rig test development time and cost than other gas turbine engine components. Though combustors have been the component least amenable to analytical design, recent techniques have shown the potential of significant reductions in development time and cost. Analytical math models will be refined and validated by full-scale rig tests of a small (2-5 PPS) annular combustor. This technology will provide a shorter, lower cost development cycle for future Army gas turbine helicopter engines.

Existing combustor math models will be refined and validated by elemental testing, i.e., fuel injection, liner cooling. Full-scale high- pressure rig tests will validate the entire design procedure. The following phases (and percentage of total effort) will be conducted: (1) analytical model refinement (33 percent), (2) full-scale combustor design, fabrication, and preliminary test (38 percent), (3) combustor performance mapping (20 percent), and (4) limited modification and retest (9 percent).

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0004, ADVANCED ANTI-DEICING CAPABILITY FOR ARMY ROTARY WING AIRCRAFT

J.B. WERNER, Lockheed Aircraft Corporation, *Burbank, California* 91503 (DA0D3877; DAAJ02-73-C-0107)

The objectives of this program are to establish icing severity levels against which future Army helicopter ice protection system should be designed and to advance helicopter ice protection technology.

The probability of various icing severity levels will be established along with ice protection state-of-the-art. Future Army aircraft missions will be evaluated to establish probability of icing encounter. Trade-off analyses will be performed using various icing severity levels, various ice protection techniques for various aircraft types and missions, to establish optimized ice protection system design requirements. The effort will include design and test development of an optimum ice protection system for the UH-1H helicopter for test and evaluation. Analysis and documentation of program results will be performed for publication.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Lab., Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0005, VHF/FM PRECISION HOVER

C. INSKEEP, Communications Components Corp, *Costa Mesa, California* 94527 (DA0D2802; DAAB07-74-C-0523)

The objective of this program is to develop a VHF/FM precision hover system that will give Army aircraft the ability to locate and accurately maintain position over ground-based troops equipped with standard VHF/FM transceivers. The information displayed by the precision hover system would be used to locate ground-based troops for purposes of logistics support, personnel deployment, tactical air support and medical evacuations.

Maximum use will be made of the airborne FM receiver to provide the precision hover function. A small antenna assembly consisting of an antenna array and the appropriate electronic circuits would comprise the precision hover system.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Avionics Laboratory, U.S. Army Electronics Command, Fort Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

1.0006, OH-6 SIMULATION ANALYSIS

C.E. DAVIS, Summa Corporation, *Culver City, California* 90230 (DA0D3932; DAAJ02-74-C-0047)

Under FY 72 Contract DAAJ02-72-C-0090, the Army developed an R & M simulation model to evaluate current and conceptual Army aircraft. Under FY 73 Contract DAAJ02-73-C-0096, a more advanced model, the ARMS model, is being developed. The objective of this effort is to develop valid R & M simulations of the OH-6 helicopter. The contractor will develop the reliability, maintainability, and combat damage data elements necessary to simulate the OH-6 in the Army R & M simulation model and in the ARMS (Aircraft Reliability and Maintainability Simulation) model. Sensitivity studies will be conducted to determine critical support and effectiveness parameters.

Develop OH-6 reliability, maintenance, and combat damage elements to the component level for organizational, direct and general support levels. Perform validation and parametric analyses using the R & M simulation model and the ARMS model. Contractor shall isolate the critical support, reliability and maintainability elements.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0007, CALCULATION OF AIRCRAFT RADAR CROSS SECTION (RCS)

H. HEATH, Northrop Corporation, *Hawthorne, California* 90250 (DA0D3954; DAAJ02-75-C-0002)

Basic contractual effort is to develop a computational procedure capable of predicting the radar cross section of U.S. Army helicopters. This program will be used as a tool in the design of new or improved helicopters to reduce their detectability on the battlefield. Provisions will be made in the program to evaluate radar signature reduction features prior to a costly development effort.

This effort is intended to utilize the past work of the Air Force, which was directed at fixed-wing aircraft, by modifying or developing new procedures to cover helicopters. Initial work will be for a reflecting surface only.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R and D Lab., Eustis Directorate, Fort Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0008, AIR MOBILITY TECHNICAL AREA I - AERONAUTICAL SCIENCES/AERODYNAMICS

I.C. STATLER, U.S. Natl. Aero. & Space Adm., Ames Research Center, *Moffett Field, California* 94035 (DA0C5000)

Conduct basic and applied research in joint participation with the NASA-AMES Research Center to provide a technological base in the aerodynamics of rotary-wing and other V/STOL aircraft. The objective is to expand the technologies in those areas which are most likely to impact improved operational and cost effectiveness, survivability and safety of future Army air mobile systems.

Analytical and experimental studies are selected on the basis of a continual review of the Army's aviation objectives and assessment of those fundamental technology deficiencies which would prevent achievement of the desired objectives. Rotary-wing research will be conducted to develop or improve analytical tools, prediction techniques, and fundamental understanding related to the basic fluid mechanics, acoustics, rotary-wing dynamics and control and flight simulation, and are influenced by the availability of technical personnel and facilities, such as the 7-by-10 ft. low-speed wind tunnel, rotor hover performance acoutic test area, ground-based simulators, computation facilities, and other unique NASA-Ames facilities and support which can be applied to the Army's rotary-wing problems.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Laboratory, Ames Directorate, Ames Research Center, Moffett Field, Ca. 94035

SUPPORTED BY U.S. Dept. of Defense - Army

1.0009, MAINTENANCE AND DIAGNOSTICS LOGIC MODEL

R.A. DEPAUL, Detex Systems Incorporated, *Orange, California* 92667 (DA0C3522; NAS PR A10240B)

The objectives are to investigate the feasibility of utilizing an advanced logic model and to develop a maintenance logic model for performing diagnostics and fault isolation of helicopter components.

The approach taken is to identify methodology for describing the functional and physical relationship of designed hardware by identifying appropriate dependency chains and utilizing such design variables as test points and feedback conditions to create a logic model useful to repairmen and maintenance specialists which will also be useful as a design evaluation tool for ease of maintenance and repair.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Laboratory, Headquarters, Ames Research Center, Moffett Field, Ca. 94035

SUPPORTED BY U.S. Dept. of Defense - Army

1.0010, LIGHTWEIGHT ROLLING HELIX ENERGY ABSORBER INVESTIGATION

B. MAZELSKY, A R A Incorporated, *West Covina, California* 91791 (DA0D4002; DAAJ02-75-C-0015)

To determine the feasibility of a lightweight energy absorber of the rolling helix type for application as an energy-absorbing leg for crashworthy helicopter troop seats.

A lightweight rolling helix energy absorber will be designed for the crashworthy troop seat design being tested under USAAMRDL Contract DAAJ02-74-C-0036. Eight devices will be fabricated, three of which will be supplied to the government. The remaining devices shall be statically and environmentally tested. The feasibility of the design shall be assessed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0011, FEASIBILITY OF UTILIZING SIMULATED HUB FORCED VIBRATIONS IN HELICOPTER RELIABILITY TESTING

F.D. BARTLETT, Kaman Aerospace Corporation, *Bloomfield, Connecticut* 06002 (DA0D3971; DAAJ02-75-C-0004)

Determine feasibility of using ground tests to duplicate in-flight vibratory loads, structural responses, and stresses to provide a relatively low-cost early means of detecting problems and assessing corrective redesigns early in a helicopter systems development phase.

Under prior contracts a structural dynamic test method for determining the equations of motion of a simple structure was developed and experimentally verified. Further demonstration through application of the method to a full-scale helicopter is planned by this directorate. More recently, Kaman Aerospace has extended the theory, devising a method for determining rotor hub loads (forces and moments) directly from measured fuselage accelerations. Presently, there is no generally effective method for measuring hub loads. Results of this first phase will verify the extended theory and establish its engineering practicality, evaluating calibration procedures, data collection, and data handling techniques, effects of measurement error, and the sensitivity to changes such as gross weight.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Lab., Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0012, FAILSAFE COMPOSITE ROTORHUB CONCEPT

R. MAYERJAK, Kaman Aerospace Corporation, *Bloomfield, Connecticut* 06002 (DA0D3976; DAAJ02-75-C-0013)

Fiber-reinforced composite materials have demonstrated their applicability in high-performance aircraft structures such as helicopter rotor blades, wings, rudders and sections of fuselage. The feasibility of fabricating a helicopter main rotor hub using

composite materials has been demonstrated under contract with Whittaker Corporation, Research and Development Division. The objective of this program is to develop improved low-cost failsafe rotor hub technology. The use of composite materials can both reduce initial cost and provide a failsafe structure at no increase in weight.

Evaluate new hub concepts for low cost, low weight, ballistic resistance, radar reflectivity, and reliability and maintainability aspects. The better concept will be selected for further development, which will include material and subcomponent fabrication and testing. After analysis of the test results, the hub design will be updated.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Lab., Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0013, INVESTIGATION OF FACTORS CONTROLLING ENGINE-SCHEDULED OVERHAUL INTERVALS

P.A. KING, Avco Corporation, *Stratford, Connecticut* 06497 (DA0D3980; DAAJ02-75-C-0018)

Perform a detailed review and analysis of all applicable technical factors affecting the establishment and growth of scheduled overhaul intervals of aircraft turbine engines to determine the engine design, test and airframe integration requirements essential to achieve a significant increase in initial TBO's and TBO growth rates. The results will provide a basis for TBO control of current and future Army turbine engines.

Review past turbo-shaft engine reliability behavior, design margins, fault warning and developmental testing to establish causal factors for low, or limited, scheduled overhaul intervals. Upon assessment of degree of responsibility of each causal factor, criteria and recommendations are to be generated which would lead to high initial TBO's and rapid TBO growth for future engine programs.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0014, TURBINE TIP CLEARANCE MEASUREMENT, ARMY AIRCRAFT

S.D. WHITE, Avco Corporation, *Stratford, Connecticut* 06497 (DA0D4010; DAAJ02-75-C-0051)

The objective is to obtain realistic data including accurate tip clearance measurements for use in evaluating, validating and refining turbine tip clearance prediction techniques in order to provide the gas turbine designer with a useful tool for analyzing operating tip clearances and for designing effective tip clearance control techniques. The resulting tip clearance reductions will provide improved performance in small gas turbine engines yielding reduced fuel consumption at all engine power levels and minimizing hardware damage during engine development.

The approach will be to generate transient and steady-state data on both the rotating and static components of the Lycoming STAGG gas generator first-stage turbine during actual full-power operation, and use the data to substantiate the various rotor/shroud growth calculation techniques used in tip clearance prediction. Final comparison will be made to actual measured tip clearance which will be obtained utilizing advanced laser-optics instrumentation developed under a previous Eustis Directorate Contract. The data will not only provide a basis for analytical tool refinement, but will also describe the actual real-time response of the turbine components including the cantilevered-type shroud typical of many Army gas turbine engines.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0015, ADVANCED OVERRUNNING CLUTCH PROGRAM, ARMY AIRCRAFT

J. KISH, Sikorsky Aircraft Company, *Stratford, Connecticut* 06602 (DA0D3920; DAAJ02-74-C-0028)

This program consists of the investigation of helicopter overrunning clutch concepts with the objective of providing technology necessary to design clutches characterized by improvements in performance, weight, and reduced developmental and unit cost, while maintaining very high reliability and maintainability.

The program is a four-phase program outlined as follows: Phase I and II - the work consists of an analytical investigation and preliminary design of proposed clutches and outlining an analytical design tool for later verification. Phase III - selected clutches will be detail designed in conjunction with formulation of detail analytical design tool. A test program shall be developed with the objective of validating the analytical design tool. Phase IV - specific clutch configurations shall be fabricated and tested. All test data will be analyzed to substantiate the analytical design tool and identify possible design deficiencies. All design deficiencies will be corrected via redesign with follow-on verification test. A product of this program will be a design guide for aircraft clutches.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R and D Lab., Eustis Directorate, Fort Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0016, DYNAMIC TESTING OF UTTAS YUH-60A SEATING SYSTEMS

F. KNAPP, Sikorsky Aircraft Company, *Stratford, Connecticut* 06602 (DA0D4013; DAAJ02-75-C-0056)

To purchase prototype UTTAS YUH-60A seating systems for later evaluation of their crashworthiness.

These seats will be dynamically tested to the requirements of MIL- S-58095 and USAAMRDL TR 71-22. The testing will be performed by the Crew Systems Division, Naval Air Development Center, Warminster, Pa., during FY 76.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0017, ADVANCED TECHNOLOGY COUPLINGS (MODIFIED MISALIGNMENT COUPLINGS) FOR HELICOPTER TRANSMISSION SYSTEMS

R.A. STONE, Sikorsky Aircraft Company, *Stratford, Connecticut* 06602 (DA0D3940; DAAJ02-74-C-0054)

This program will consist of the investigation of new as well as current helicopter coupling concepts with the overall objective of providing the technology necessary to design couplings characterized by improvements in performance, (i.e., misalignment, speed, torque) and weight, very high reliability and good maintainability.

The program is a four-task program outlined as follows: Task I - the work to be performed shall consist of an extensive investigation of the capabilities and limitations of current helicopter and industrial couplings, with regard to speed, torque, misalignment, lubrication, reliability and maintainability. Task II - selected coupling candidates will undergo a detail design in conjunction with the formulation of an analytical design technique which will be applicable to any range of speed, torque, misalignment, etc., for the concepts chosen. Tasks III and IV - specific coupling configurations shall be fabricated and tested. All test data will be analyzed to substantiate the analytical design guide, to validate potential performance gains, and identify possible design deficiencies. All design deficiencies will be corrected by redesign with follow-on verification tests.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0018, ADVANCED CONCEPT TRANSMISSION SYSTEM, ARMY HELICOPTERS

A. KORZUN, United Aircraft Corporation, *Stratford, Connecticut* 06497 (DA0D3985; DAAJ02-75-C-0023)

The purpose of this program is to formulate a conceptual design and a component development and test program for a helicopter transmission which could enter engineering development in the 1980-90 time frame.

A. Define the baseline contemporary helicopter drive system technology, to include weight, cost, survivability, reliability, and maintainability. B. Based on the above, determine the technology development requirements for each transmission component that must be considered to attain the objectives. C. Prepare a technical report containing the conceptual design and proposal for a component technology development and test program.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Eustis Directorate, U.S. Army Air Mobility Research & Development Laboratory, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0019, RESEARCH ON HELICOPTER ROTOR NOISE 13517-EX

H. LIEBOWITZ, George Washington University, School of Engin. & Appl. Sci., *Washington, District of Columbia* 20006 (DA0E9139; DAAG29 76 G0259)

To extend current knowledge of high-speed helicopter rotor noise by determining the influence of non-compact source distribution on high- speed rotor blade tips, the influence of aerodynamic pressure distribution on radiated near- and far-acoustic fields and influence of unsteady pressure fluctuations on radiated noise. Relevance - high-speed rotor noise studies are very relevant to Army missions of the next few years. Blade slap must be reduced if the true advantages of nap-of-the- earth flight are to be realized. This study is also relevant to determining detectability, community annoyance and possible effects of FAR 36 on new helicopter designs.

The non-homogeneous wave equation describing the radiated acoustic pressure will be solved both analytically, where possible, and numerically in a form that removes the restrictions of compactness, hovering rotors, far-field approximation, geometry, and mathematical singularities characteristic of high tip speeds.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

1.0020, A LIMITED-VORTEX-WAKE ANALYSIS OF HOVERING HELICOPTER ROTORS 11630-E

R.B. GRAY, Georgia Inst. of Technology, School of Engineering, *Atlanta, Georgia* 30332 (DA0D9146; DAAG29 76 G0007)

To predict helicopter rotor wake geometry in hovering flight. Information about the near-free wake generated by the rotor blades of a hovering helicopter is of considerable interest to the Army. The influence of this wake directly affects the payload lifting capacity of the vehicle close to the ground at lift-off as well as the aerodynamic stability of the aircraft under gusting conditions near the ground.

This investigation will be directed toward an analytical and experimental study of a helicopter wake model using a helicopter rotating single blade. An initial wake geometry will be determined. This, in turn, will be truncated at various distances below the rotor and the effect on the computed geometry and strength distribution will be observed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, ARO-D, Durham, N.C. 27706

SUPPORTED BY U.S. Dept. of Defense - Army

1.0021, HELICOPTER CONTROL SIMPLIFICATION

J.A. STEPHENS, U.S. Army, Human Engineering Labs., *Aberdeen Proving Ground, Maryland* 21005 (DA0C4935)

To determine the feasibility of integrating and/or simplifying the characteristics of helicopter primary flight controls to achieve reduced complexity in regard to overall task loading and training of flight personnel.

The control of helicopters is characterized by two separate control devices, viz., collective and cyclic. This requirement for two-handed operation has necessitated the location of secondary control and actuation devices on the cyclic and collective sticks and, to some extent, has placed limitations on cockpit configuration. Mechanical control concepts are being designed and fabricated for utilization in the Human Engineering Laboratory's GAT simulator. The primary objective is to determine any differences in flight performance with the integrated control concept versus the current two-handed mode. Assuming success in this first phase, the control concept will be tested in a TH- 55A. The implications of an integrated control on helicopter displays and controls and cockpit configuration will also be studied.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Human Engineering Labs., Aberdeen PG, Md. 21005

SUPPORTED BY U.S. Dept. of Defense - Army

1.0022, RELIABILITY AND MAINTAINABILITY (R & M) SIMULATION MODEL MODIFICATIONS, ARMY AIRCRAFT

W.C. FRIESE, Rail Company, *Cockeysville, Maryland* 21031 (DA0D4000; DAAJ02-75-C-0037)

The objective of this effort is to enhance the capabilities of the present Eustis Directorate, USAAMRDI Aircraft Reliability and Maintainability Simulation (ARMS) and R & M Models.

An improved output program will be provided for the ARMS model which will provide additional output data and improved data formatting. An input and output program will be provided for the R & M to allow more rapid turnaround of data.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0023, HELICOPTER ROTOR NOISE STUDIES 12931-EX

W.L. HARRIS, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DA0E9066; DAAG29 76 C 0027)

To conduct experiments to identify and quantify the mechanisms of rotor noise generation at low-subsonic tip Mach number, to obtain the characteristics of the resulting acoustic field and to evaluate and varify experimentally a Mach number scaling formula for rotational noise at low tip speeds. This research is directly relevant and contributory to the research investigations on helicopter rotor noise at both the Langley and AMES Directorates of AMRDL. The proposed investigations cover a flight regime for which there are no facilities at AMRDL and would, therefore, be highly useful in any comprehensive helicopter noise reduction program.

A unique experimental facility consisting of an open jet test section in an anechoic room will be utilized to determine the effects of blade number, advance ratio, thrust and rotor disk tilt angle on rotational noise and blade slap.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

1.0024, TURBINE TIP CLEARANCE MEASUREMENT

A.I. BELLIN, General Electric Company, *Lynn, Massachusetts* 01910 (DA0D4009; DAAJ02-75-C-0046)

The objective is to obtain realistic data including accurate tip clearance measurements for use in evaluating, validating and refining turbine tip clearance prediction techniques in order to provide the gas turbine designer with a useful tool for analyzing operating tip clearances and for designing effective tip clearance control techniques. The resulting tip clearance reductions will provide improved performance in small gas turbine engines yielding reduced fuel consumption at all engine power levels and minimizing hardware damage during engine development.

The approach will be to generate transient and steady-state data on both rotating and static components of the T-700 engine first-stage turbine during actual full-power operation, and use this data to substantiate the various rotor/shroud growth calculation techniques used in tip clearance prediction. Final comparison will

be made to actual measured tip clearance which will be obtained utilizing advanced laser- optics instrumentation developed under a previous Eustis Directorate Contract. The data will not only provide a basis for analytical tool refinement, but will also describe the actual real-time response of the turbine components including the hanger-type shroud typical of many Army gas turbine engines.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0025, DEVELOPMENT OF PARTIAL CHANNEL FLOW FOR ARBITRARY INPUT VELOCITY DISTRIBUTIONS USING BOUNDARY-FITTED COORDINATE SYSTEMS 13675-EX

L.R. HESTER, Mississippi St. University, School of Engineering, *Mississippi State, Mississippi* 39762 (DA0E9022; DAAG29 76 G0144)

To develop numerical solutions for time-dependent two-dimensional incompressible laminar partial channel flow. This investigation is directly relevant to research on fluidic devices, utilized, for example, in such Army applications as helicopter and tank stabilization systems, being conducted at HDL and impacts on the techniques for modeling of flows in rivers, estuaries, and coastal seas being carried out at Waterways Experiment Station.

A numerically generated curvilinear coordinate system having a coordinate line coincident with the boundary contour will be utilized for solving the Navier-Stokes equations of viscous fluid mechanics describing flows through arbitrarily shaped channels.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

1.0026, IEMCAP F-15 VALIDATION

R. PEARLMAN, McDonnell Douglas Astro. Corp., *St. Louis, Missouri* 63166 (DF736800; F30602-76-C-0193)

The objective of this effort is to provide a validation of the Intrasystem EMC Analysis Program (IEMCAP) code. This is necessary to determine prediction accuracies using the different component models as well as the over-prediction resulting from frequency quantization and spectrum approximation.

The approach will be to break the F-15 aircraft up into a number of mini-systems and analyze them using the IEMCAP. These mini-systems will exercise different subroutines and models of the IEMCAP. The output of the analyses will be compared to experimental F-15 data. From this comparison conclusions on the effect of program assumptions and approximations will be formulated for future reference.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center RBC, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0027, MICROWAVE AIRCRAFT DIGITAL GUIDANCE EQUIPMENT

R. BORISS, U.S. Army, Avionics Laboratory, *Red Bank, New Jersey* 07703 (DA0C3438)

To evaluate a United Kingdom portable microwave landing guidance system known as MADGE (Microwave Aircraft Digital Guidance Equipment).

A joint services (Army and Air Force) evaluation team will observe/participate in the United Kingdom's test and evaluation of MADGE at the Blind Landing Evaluation Unit (BLEU) in Bedford, England.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Army Avionics Laboratory, Army Electronics Command, AMSEL-UL-N-L, Ft. Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

1.0028, MULTIPLE AIRCRAFT APPROACH LANDING TECHNIQUES

J. VOLPE, Cutler Hammer Incorporated, *Farmingdale, New York* 11735 (DA0C3435; DAAB07-73-C-0208)

The objective of this task is to determine the ability of candidate tactical landing systems to provide useable guidance for multiple (closely spaced) aircraft landings. Under this task a collocated KU-band landing interrogator set will be integrated with an AN/TPX-42, the DoD standard ground interrogator set. Also, the A-SCAN airborne landing set (an Army Exploratory Development Equipment) will be interfaced with the standard airborne transponder AN/APX-72. The total system will operate in a crossbanded mode wherein the airborne L-band transponder is caused to reply to 'interrogating' KU-band scanning beam landing system signals which are, at the same time, providing the pilot with the usual approach and landing information. With this system, the positions of several aircraft performing simultaneous approaches to the landing system can be determined (on the ground) with a resolution satisfactory for high- density landing experimentation.

The contractor will design, develop, fabricate, test and integrate interconnect a KU-band landing/interrogator set with the AN/TPX-42 interrogator set for crossbanded operation. Laboratory, field and flight tests sufficient to demonstrate the suitability of the equipment will be conducted by the contractor prior to delivery to USAECOM. Further testing will be conducted at USAECOM, where the equipment will be subjected to a high-density helicopter landing environment.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Avionics Lab., AMSEL- VL-G AMSEL-VL-N, Ft. Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

1.0029, INVESTIGATION OF SMALL TURBINE AERODYNAMICS T-4-E

W. TABAKOFF, Univ. of Cincinnati, School of Engineering, *Cincinnati, Ohio* 45221 (DA0C8956; DAAG29 69 C 0016)

To study the basic phenomena underlying the performance of air- breathing propulsion systems to increase performance by improving the turbomachinery, reducing the overall engine weight, improving the structural design and improving the performance of the nozzle. This project is directed toward those metallurgical and aerodynamical features indigent to the design and performance of air-breathing propulsion engines such as gas turbines used for military purposes. In attaining best engine efficiency, aerodynamic knowledge of the gas or air flow about the turbine blades is very necessary. It is equally necessary that proper cooling methods and better turbine blade materials be developed for the blade to protect it from burnout or over heating.

Theoretical and experimental investigations are planned in the following areas: heat transfer, cascade flow, stresses and vibrations, blade erosion and solid-particle impingement, gas-flow mixing, transonic nozzle performance, high-temperature materials, and dynamic distortion. All of the studies will be oriented toward high-temperature analyses, since advanced systems will operate at significantly higher engine-cycle temperatures.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

1.0030, RELIABILITY AND MAINTAINABILITY

E.E. BAILEY, U.S. Natl. Aero. & Space Adm., Lewis Research Center, *Cleveland, Ohio* 44135 (DA0E3531)

Implement research and development program for improvement in the reliability and maintainability of present and future Army aircraft propulsion and drive train system components. Provide the technology for high-speed turbomachinery, transmission, and shafting, aimed at increased operational life components and materials, plus capacity for operation in varying environments.

In joint participation with NASA-Lewis Research Center, programs are formulated and executed to obtain bearings, seals, shafting, and lubrication systems with capabilities of operation for extended periods at increased speeds, temperatures, and pressures which are indicated for advanced propulsion systems. Com-

ponents, based on advanced concepts, will be designed, fabricated, and evaluated under simulated operational conditions.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Laboratory, Lewis Directorate, 21000 Brookpark Road, Cleveland, Oh. 44135

SUPPORTED BY U.S. Dept. of Defense - Army

1.0031, DIAGNOSTIC/INSPECTION INTERFACES, ARMY AIRCRAFT

J. DOUGHERTY, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D3916; DAAJ02-74-C-0030)

To study combinations of diagnostic concepts and maintenance/inspection technology in an attempt to establish more optimized schemes for determining the mechanical and structural conditions of Army aircraft.

The objective will be accomplished in two tasks: the first will include a review of various diagnostic, inspection and maintenance studies/developments for the purpose of determining potentially effective diagnostic/inspection/maintenance combinations; and, the second task will require the development of an analytical method for assessing diagnostic/inspection/maintenance requirements, and the impact of these requirements upon aircraft effectiveness. From this alternate schemes will be ranked.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Lab., Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0032, ADVANCED HELICOPTER STRUCTURAL DESIGN INVESTIGATION

D.J. HOFFSTEDT, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D3953; DAAJ02-74-C-0066)

To define advanced structural configurations, utilizing the latest analytical, material and fabrication technology to satisfy requirements of structural efficiency, fail safety, safety and producibility/cost, for a helicopter of the 7000-9000 gross-weight class.

The technical approach to the program will be in accordance with following tasks: A. Task I - develop a preliminary design of a baseline aircraft (conventional structure) and preliminary design of aircraft incorporating various advanced structural concepts. B. Task II - conduct weight, cost, and safety analysis of selected designs. C. Task III - conduct advanced aircraft design and baseline (conventional) aircraft comparison with respect to weight, performance, size, cost, etc. D. Task IV - conduct risk/feasibility assessment of the selected design concepts and identify supporting research efforts for highest technology risk areas. E. Task V - free-planet application study.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R and D Lab., Eustis Directorate, Fort Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0033, ADVANCED CONCEPT TRANSMISSION SYSTEM, ARMY HELICOPTERS

A.J. LEMANSKI, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D3984; DAAJ02-75-C-0022)

The purpose of this program is to formulate a conceptual design and a component development and test program for a helicopter transmission which could enter engineering development in the 1980-90 time frame.

A. Define the baseline contemporary helicopter drive system technology, to include weight, cost, survivability, reliability, and maintainability. B. Based on the above, determine the technology development requirements for each transmission component that must be considered to attain the objectives. C. Technical report containing the conceptual design and proposal for a component technology development and test program.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Eustis Directorate, U.S. Army Air Mobility Research & Development Laborat Ft. Eustis, Va. 23604

SUPPORTED BY U. Dept. of Defense - Army

1.0034, HELICOPTER CRASHWORTHY TROOP SEAT TESTING

M.J. REILLY, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D3928; DAAJ02-74-C-0036)

The objective of this effort is to: (1) test and evaluate the forward- and afterward-facing troop seat systems previously designed and mocked-up under Contract No. DAAJ02-C-0077, (2) recommend modifications to the proposed draft general military specification entitled MIL-S- XXXX(AV), 'Seat, Helicopter Troop' and USAAMRDL Technical Report 71-22, and (3) deliver to the Eustis Directorate one forward-facing troop seat test article of the approved detail design.

The troop seats of the design(s) developed and mocked-up during Contract DAAJ02-72-C-0077 will be fabricated and subjected to static and dynamic testing to permit publication of a draft military specification for troop seats.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0035, RELIABILITY AND MAINTAINABILITY (R & M) AND PERFORMANCE ISSUES IN HYDRAULIC SYSTEM DESIGN

J. SILVA, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D3987; DAAJ02-75-C-0020)

Analyze helicopter hydraulic system deficiencies and establish areas of potential improvement with respect to increased reliability, maintainability, safety, survivability, vulnerability, and decreased weight and cost.

The program will be accomplished in four phases. Phase I will establish the state-of-the-art in current helicopter hydraulic systems. Phase II will define potential areas of improvement in conventional aircraft hydraulic systems (to include changes in system pressure). Phase III will examine the effects of large increases in system pressure (in the 5-10,000 psi range). Phase IV will compare optimized 3,000 psi and very high pressure (VHP) systems. A final report will be due in December, 1976.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0036, INVESTIGATION OF AEROELASTICALLY ADAPTIVE ROTORS

F. TARZANIN, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D4016; DAAJ02-75-C-0040)

Investigate the improved rotor performance, loads, stability, and control characteristics thus providing greater aircraft performance, better handling qualities, and reduced maintenance costs, by configuring a rotor to exploit its inherent tendency to deform elastically, in response to low-frequency aerodynamic loadings. Determine if significant improvement in rotor technical characteristics can be obtained without sacrificing maintainability and reliability at the cost of increasing control system complexity.

Conduct analysis and model tests to investigate the effects of blade planform, sweep, and droop with respect to control axes, camber, torsional frequency, bending frequencies, and inertial characteristics on rotor performance, loads stability, and vibration. Effort will be made to identify specific combinations of configuration characteristics which will optimize each rotor's technical characteristics, e.g., vibrations, and then to identify configurations giving optimization of performance, loads, stability and vibrations in a global sense.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Eustis Directorate, Air Mobility R & D Laboratory, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0037, STRUCTURAL CRASHWORTHINESS SIMULATION AND ANALYSIS, ARMY HELICOPTERS

E. WIDMAYER, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D4004; DAAJ02-75-C-0014)

Formulate and verify by structural specimen testing, cost-effective analytical and simulation techniques which will enhance the crashworthy helicopter structural design process.

Current helicopter structural crashworthiness analytical practices will be investigated. Designer-oriented analytical techniques for predicting structural crash impact behavior shall be developed and their validity assessed by static and dynamic testing of helicopter structural sections. It will be demonstrated how the analyses and test data generated in conjunction with the structural crashworthiness simulation computer program KRASH can facilitate the crashworthiness of a helicopter design. Improvements to KRASH will be recommended and a proposed structural crashworthiness design guide prepared.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0038, TRANSIENT AIRFLOW MEASUREMENT

S. WEBOFER, Arnold Research Org. Inc., *Tullahoma, Tennessee* 37389 (DF420953; F40600-75-C-0001)

The objective of this effort is to develop a method to measure engine transient airflow and to calibrate an Air Force Aero-Propulsion Laboratory (AFAPL) engine inlet bellmouth system for use in transient airflow testing of a J85 engine.

An experimental test facility will be fabricated using a critical flow venturi in series with a throttling plug assembly (TPA). The TPA will consist of a shrouded bulletnose and strut assembly and a translating variable-area plug. The TPA will be calibrated for airflow rates as a function of plug position.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Arnold Engineering Development Center, Arnold AFS, Tn. 37389

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0039, THE DEVELOPMENT AND APPLICATION OF A SIMPLE METHOD FOR DETERMINING UNSTEADY AIRLOADS IN SUBSONIC COMPRESSIBLE FLOW 11695-E

W.P. JONES, Texas A & M University System, School of Engineering, *College Station, Texas* 77843 (DA0E8919; DAAG29 76 G0241)

To study unsteady aerodynamic theory relating to the determination of the airloads on aircraft and helicopters in high-speed subsonic flight. Work in progress at AMRDL-Langley for predicting lifting surface loads on hovering and advancing rotors is similar to the approach proposed by Jones and Rao. This proposal is directly related to developing technology for reducing both cost and time in performing load analyses on Army helicopters.

A simple numerical lifting surface technique based on the velocity potential formulation for calculating the aerodynamic coefficients on oscillating wings and advancing rotors is to be utilized.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

1.0040, AERODYNAMIC AND STRUCTURAL LOADS SURVEY OF A HELICOPTER ROTOR DURING OPERATIONAL MANEUVERS

C. COX, Bell Helicopter Company, *Fort Worth, Texas* 76101 (DA0D3870; DAAJ02-73-C-0105)

A knowledge of the aerodynamic and dynamic phenomena associated with the operation of a teetering rotor during high-speed maneuvers is desired. Accordingly, the immediate objective of this program is to comprehensively instrument and flight test an AH-IG helicopter to acquire the necessary data to quantitatively describe the rotor's operation and the attendent responses of the total vehicle during flight. The description of the vehicle that will be provided by this type of data will result in more accurate prediction tools and, consequently, improved design criteria and military specifications. An immediate usage for such data would be in support of the current AAH helicopter development program.

An AH-LG will be extensively instrumented to measure blade span and chordwise pressures, stresses, and motions and attendant airframe response for various flight conditions, particularly high-speed maneuvers. Predictions of aerodynamic and structural loads made prior to flight using the Bell C-81 computer program will be compared to measured data.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0041, ON-CONDITION CRITERIA ANALYSIS FOR DYNAMIC COMPONENTS OF UH-1 AND AH-1 HELICOPTERS

G. KNUDSEN, Bell Helicopter Company, *Fort Worth, Texas* 76101 (DA0D3943; DAAJ02-74-C-0060)

To determine the capability of UH-1 and AH-1 helicopter transmissions, gearboxes, main rotor hub, and swashplate to operate without the necessity of scheduled overhauls.

The methodology described in USAAMRDL Technical Report 73-58, 'Analysis of Criteria for on-Condition Maintenance for Helicopter Transmissions,' will be used to analyze failure and depot overhaul data for the UH-1 and AH-1 transmissions. In addition, a failure modes and effects and criticality analysis (FMECA) will be performed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0042, RESEARCH IN STRUCTURES

J.L. SHIPLEY, U.S. Natl. Aero. & Space Adm., Langley Research Center, *Hampton, Virginia* 23665 (DA0E3550)

To conduct basic research to provide the fundamental structures and materials application technology necessary for a viable structures program. Efforts include the development of analytical techniques for advanced structures, development of the fatigue and fracture characteristics of the structures, development of an understanding and prediction of fracture mechanisms in composite materials and the demonstration of advanced materials on Army helicopters.

Development of structural analysis techniques will emphasize interdisciplinary design programs and continuation of application of NASTRAN to helicopters. Fatigue and fracture mechanics will involve analytical and experimental investigations of the bond failure mechanisms in composite laminates and determination of environmental effects on the fatigue life of composite materials. Application of composites to helicopters will include the development of structural criteria for the bearingless rotor and the evaluation of service experience with the boron-reinforced CH-54 tail cone. The prestressed rotor spar concept will be evaluated for its capability to retard fatigue crack growth and a structural dynamics model of the AH-1G will be developed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Laboratory, Langley Directorate, Hampton, Va. 23665

SUPPORTED BY U.S. Dept. of Defense - Army

1.0043, AERONAUTICAL TECHNOLOGY, TECH AREA I - AERODYNAMICS TECHNOLOGY

J.L. SHIPLEY, U.S. Natl. Aero. & Space Adm., Langley Research Center, *Hampton, Virginia* 23665 (DA0E3551)

Develop and demonstrate the technology, techniques, and design criteria necessary to provide adequate performance, stability, control, and handling qualities for the Army's rotary wing missions, and to improve the capability to analyze and predict these characteristics in existing and future aircraft. This technology is necessary to increase aircraft availability and survivability as well as provide for improved operational effectiveness and mission capability of Army aviation systems.

Objectives are accomplished by conducting analytical, ground-based simulations, whirl-tower, wind-tunnel, and flight-test investigations in joint participation with NASA. Research will

include wind-tunnel and flight test of advanced airfoils and tip shapes, design of a V-tail configuration and improvements in forward-flight performance analysis. Acoustics research will be conducted to identify noise sources, improved prediction capability, and development of methods for reducing noise without performance degradation. The all-weather teminal area operations program will be continued to develop criteria with respect to handling qualities, control, and display requirements. Analysis and flight tests will be conducted to continue improvement in the area of helicopter stability derivative extraction techniques.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Laboratory, Langley Directorate, Mail Stop 266 NASA-LRC, Hampton, Va. 23665

SUPPORTED BY U.S. Dept. of Defense - Army

1.0044, RESEARCH IN AERODYNAMICS

J.L. SHIPLEY, U.S. Natl. Aero. & Space Adm., Langley Research Center, *Hampton, Virginia* 23665 (DA0E3553)

To conduct basic and applied research to develop or improve analytical techniques, prediction techniques, measurement techniques, and design data related to rotary wing-airfoil development, unsteady aerodynamic phenomena, rotor wake characteristics, and tip vortex generation and propagation. Investigations are selected based on continual review of the Army's aviation objectives and assessment of those fundamental technology shortcomings which would prevent or restrict achievement of these objectives.

In joint participation with NASA, analytical and experimental programs will be conducted to develop rotor airfoils which are based on mission profiles and empirically derived environments. Unsteady experimental and analytical research will be conducted to develop an understanding of and the capability to analyze and predict rotor unsteady aerodynamic characteristics. Experimental programs will be conducted to quantify rotor wakes, to develop methods for drag reduction and to determine rotor performance and helicopter interference effects.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Laboratory, Langley Directorate, Mail Stop 266 NASA-LRC, Hampton, Va. 23665

SUPPORTED BY U.S. Dept. of Defense - Army

1.0045, HT PP 74-8- REDUCED COSTS OF AIRCRAFT GAS TURBINE ENGINE COMPONENTS

T.D. BALLIETT, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D3897)

Conduct detailed cost analysis of gas turbine propulsive systems components. Initial effort will be directed at establishing a baseline of current engine component development and acquisition cost. Objective will be to identify areas which have potential for reducing life-cycle costs and to investigate areas where additional effort is needed.

In-house review shall be conducted to define cost elements and identify areas where significant cost reduction can be made. Review manufacturing techniques currently being used or contemplated for use by industry, including the UTTAS engine development program to determine feasible cost-reduction techniques. Review current Air Force, Navy and EPA low-cost engine efforts and their applicability to Army requirements. Subject to availability of funds, initiate contractual efforts supplemental to the current T53 engine cost analysis program for determination of baseline engine component cost.

SUPPORTING AGENCY ADDRESS INFORMATION: AVSCOM Air Mobility R & D Lab., Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0046, HT RM 75-28- ADVANCED TECHNOLOGY HELICOPTER EXTERNAL CARGO SLINGS

S. HOLA, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D3978)

To advance the technology of helicopter external cargo slings to reduce weight, increase flexibility and improve handling qualities.

Perform a survey to determine the most promising of newly developed materials (such as Kevlar PRD 29). Investigate various material construction techniques and end fitting attachment methods. Perform tensile, fatigue, vibratory and environmental tests on selected material specimens by utilizing other government agencies, e.g., National Bureau of Standards, and AMMRC. Deliver a quantity of sling legs, compatible with existing attachment hardware, to the government for flight testing.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0047, HT 74-16- FIELD APPLICATION OF SONIC ANALYSIS

R.J. HUNTHAUSEN, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D3935)

Further investigate the feasibility of applying acoustic acquisition and analysis techniques to inspect and diagnose the mechanical condition of helicopter engines, transmissions and gearboxes without disassembling or removing these components from the aircraft. Significant safety and maintenance benefits could accrued from this work.

Analyze the acoustic signatures of two high-time UH-1 helicopters whose engines and powertrain components are implanted with degrated gears and bearings. Data will be acquired on the ground at various rotor speeds via condenser microphones selectively positioned next to the aircraft. Frequencies approaching 100 KHz will be recoverable.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0048, HT PP 75-20- SUCTION FUEL CONTAMINATION TEST

A.S. MYSINEK, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D3962)

To determine if the suction fuel system, as proposed on the Utility Tactical Transport Aircraft System (UTTAS), poses potential problems in regard to contaminant ingestion.

A. Design and fabricate a mock-up of proposed UTTAS suction fuel system. B. Conduct tests to determine the following: (1) size/density of contaminates subject to suction; and (2) quantity of contaminants subject to suction/unit time. C. Conduct a cursory analysis to determine the adverse effects of contaminants ingested into fuel control. Determine filtration requirements.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Lab., Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0049, AN INVESTIGATION OF SEPARATION MODELS FOR THE PREDICTIONS OF MAXIMUM LIFT COEFFICIENT 13225-EX

F.A. DVORAK, Analytical Methods Inc., *Bellevue, Washington* 98004 (DA0E9013; DAAG29 76 C 0019)

To develop a gas-flow separation model which, when combined with an existing viscous/potential flow interaction analysis, results in a method capable of predicting airfoil or rotor performance at or beyond maximum lift coefficient. The proposed research will provide fundamental information for the prediction of helicopter performance and is thus highly relevant to the ARMDL mission.

Three separation models, two utilizing source distributions for representing the separated flow and the third utilizing a vorticity distribution for representing the free-shear layers leaving the airfoil surface, will be evaluated for use in predicting maximum lift coefficient.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, INVESTIGATION OF PROPERTIES OF HIGH-ENERGY INFRARED LASER WINDOW MATERIALS
J.A. HARRINGTON, Univ. of Alabama, Graduate School, *Huntsville, Alabama* 35807 (DA0E1358; DAAH01-74-C-0438)

Investigate methods which show promise in providing improved window materials for use with intense laser beams from the chemical to carbon dioxide wavelengths.

Comparisons will be made between various chemical and mechanical polishing schemes. The comparison will be made on state-of-the-art window materials having high mechanical strengths and low bulk absorption at the desired wavelengths. Testing of various materials will be done in a high-energy pulser laser.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MICOM Physical Sciences Directorate, MICOM Missile Research Dev. & Eng. Lab., MICOM Army Missile Command, Redstone Arsenal, Al. 35809

SUPPORTED BY U.S. Dept. of Defense - Army

3.0002, FUNDAMENTAL RESEARCH STUDY OF PLASTIC FLOW AND FRACTURE IN BERYLLIUM 13387-MS
D. WEBSTER, Lockheed Missiles & Space Co., *Palo Alto, California* 94304 (DA0E9130; DAAG29 76 C 0051)

To study plastic flow and fracture of fine-grained beryllium. Studies will be made of possible dislocation movements, pyramidal slip, room-temperature grain-boundary sliding, and the roles of microstructure, temperature and intermetallic compounds in fracture. Relevance - the proposed research is relevant to a host of Army applications in missile structures and in areas in general in which high strength and stiffness with light weight are required.

Beryllium will be cast from electrolytic flake and thermomechanically treated by upset forging to produce a nontextured product, and by extrusion to develop a highly textured product. Dislocation structures and morphology, boundary structures, evidence for grain boundary sliding, and other micromechanisms will be analyzed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0003, FATIGUE DAMAGE INDICATIONS IN HIGH-STRENGTH AIRCRAFT ALLOYS
S.J. TAO, New England Institute Inc., *Ridgefield, Connecticut* 06877 (DN590148; N00019-76-C-0447)

To determine the levels of dislocation and vacancy density in the surface zones of deformed high-strength aircraft alloys.

Positron annihilation lifetimes to correlate with dislocation and vacancy density levels after deformation of high-strength titanium, aluminum and steel alloys. Work will be extended to analyze effect of grain size and voids on positron behavior.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Naval Air Systems Command, Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0004, DOUBLE-LAYER STRUCTURE AND ELECTRODE KINETICS
R. DELEVIE, Georgetown University, School of Arts & Sciences, *Washington, District of Columbia* 20007 (DF043940; AF-AFOSR-3027-76)

AF function - electrical power for aircraft, satellite, and various subsystems is the source that keeps our communication systems and flight operations active. Deficiency - longer life, lighter weight, higher energy-density batteries are needed to meet the various operational requirements of the Air Force. Objective - investigations will be carried out on the double-layer structure at the electrolyte/electrode interface by a combination of recently developed techniques. These methods will be used to test and calibrate liquid-metal electrodes and solid electrodes. How work contributes - information on specific adsorption and on double-layer potentials is crucial to the refinement of electrode kinetics, electrocatalysis, and problems related to the electrode/electrolyte interface.

Using the recently developed technique, the kinetic probe method, double-layer potential measurements will be made on electrolyte mixtures and solid electrodes. This method will be applied to the study of ionic strength mixtures of alkali fluorides, pseudohalides, nitrates and perchlorates, as well as aqueous buffer mixtures such as phosphate, citrate, and borate. The results will be directly useful for kinetic investigations. Kinetic probes will be used to study double-layer potentials at the solid electrode/water interface, i.e., platinum, nickel, zinc and various carbons. Attempts will be made to apply bubble pressure, ultra-fast admittance (Fourier-transform), and kinetic probe techniques to double-layer effects on ion adsorption isotherms in dilute solutions, and to the simultaneous measurement of kinetic and thermodynamic data where electrochemical reactants, intermediates, or products are strongly adsorbed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Office of Scientific Research NC, Bldg., 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0005, PIEZOELECTRIC POLYMER DEPOSITION--RELATION OF DEPOSITED STRUCTURE TO ACTIVITY 13790-P
S. EDELMAN, U.S. Dept. of Commerce, Natl. Bureau of Standards, *Washington, District of Columbia* 20324 (DA0E9035)

OBJECTIVES: (1) To develop piezoelectric and pyroelectric polymers which will have enhanced electrical properties and will minimize our dependence on overseas sources of these materials, and (2) to develop a better understanding of the mechanisms of these piezoelectric and pyroelectric polymers. It has already been shown that these films have the potential of directly replacing lead zirconate-lead titanate in fuzing applications with improved performance at a lower cost. As pyroelectric elements these materials can potentially replace triglycine sulphate in pyroelectric vidicons (in at least one case this has been successfully demonstrated).

Deposit piezoelectric polymer in vacuum under a strong electric field. Determine the structure of the deposited polymer and the level of piezoelectric and pyroelectric activity. Using both theoretical and experimental approaches, relate the parameters controlling the deposition of the material to the resulting structure and to the piezoelectric and pyroelectric activity.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0006, STUDIES ON THE PENETRATION MECHANICS OF COMPOSITE PLATES 11946-E
R.L. SIERAKOWSKI, State University of Fla. Sys., School of Engineering, *Gainesville, Florida* 32611 (DA0D9240; DAAG29 76 G0085)

To study the dynamic response processes in the region where stress waves are important. All of the Army laboratory reviewers point out the relevance of this work to current Army and DoD needs. The work is of immediate use to helicopter design, personnel ARMOR, aircraft survivability and, in fact, to all situations where the dynamics of composites is a problem.

An analytical and experimental program for partial penetration of composite plate-type structures will be performed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0007, STUDY OF INTERMETALLIC COMPOUNDS
J. MILLER, United Technologies Corp., *West Palm Beach, Florida* (DF680850; F33615-75-C-1166)

The objective of this program is to determine the suitability and potential of titanium aluminum (TiAl) base materials for use in aircraft turbine engines. It is of specific importance to study the response of this material, as an example of a class of materials, to the stresses, strains, and environment found in a gas turbine engine.

The program shall consist of the selection, preparation, processing, and characterization of a suitable composition based on the intermetallic compound TiAl. At the same time the manufacturing process steps necessary to produce turbine blades shall be explored and assessed. If it is determined that the necessary techniques are available, a partial set of turbine blades may be fabricated using an existing design. These blades shall be bench and rig tested and, if suitable, may be made available for later engine testing.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Materials Laboratory LLM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0008, MATERIALS SUPPORT TECHNOLOGY - PLASTIC PIEZOELECTRIC AND PYROELECTRIC MATERIALS
S.H. CARR, Northwestern University, Technological Institute, *Evanston, Illinois* 60201 (DN675052; N00014-75-C-0963)

The Navy is a user of piezo- and pyroelectric materials in detection and sensing applications. It is the purpose of this research to investigate the pyro- and piezoelectric activity of polymeric materials and to relate the structure and composition of these materials to their pyro- and piezoelectric activity.

This work will include the determination of a number of properties of polymeric materials which have been electrically polarized. These properties include the magnitude of permanent polarization, pyroelectric and piezoelectric coefficients, and mechanical anisotropy. The polymers to be studied will include, but will not be limited to polyacrylonitrile.

SUPPORTING AGENCY ADDRESS INFORMATION: Office of Naval Research, Arlington, Va. 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0009, CHEMISTRY OF ELECTRONICALLY EXCITED STATES OF ATOMS, DIATOMIC MOLECULES AND DIATOMIC IONS 12197-C
D. SETSER, Kansas State University, School of Arts & Sciences, *Manhattan, Kansas* 66506 (DA0E8980; DAHC04-75-G-0018)

To study the chemistry of electronically excited states of atoms, diatomic molecules, and diatomic ions. The proposed research should yield kinetic information such as energy transfer rates and vibrational relaxation data on electronically excited states of atoms, molecules, and ions. These results will have direct application in the evaluation of the potential of proposed laser systems. Potential for long-range usage of the results lies in the Army's Upper Atomspheric Research Program.

Spectroscopic analysis of experiments on species including n sub 2 (A(3)sigma U (plus), CO (A(3) pi), O sub 2 (plus) (A), and CO(plus) (A(2)pi) will be conducted in a flowing afterglow apparatus. These studies will yield determinations of energy transfer rate constants, insight into the mechanism for vibrational relaxation, identification of product states, and thermochemical and spectroscopic data.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0010, CALCULATION OF CERAMIC PHASE DIAGRAMS
L. KAUFMAN, Manlabs Incorporated, *Cambridge, Massachusetts* 02138 (DF042880; F44620-76-C-0060)

AF function - ceramic materials are being developed for a variety of components (e.g., blades, vanes, rotors, combustors, bearings and seals) in future gas turbine engines and for a variety of electronic and optical components in aircraft. Opportunity - the process of selecting the chemical composition and heat treatment of any material to obtain optimum properties has been a slow one based upon past experience and time-consuming experimentation. Over the past ten years computer techniques have been developed for calculating the phase diagrams of simple binary and selected ternary metal alloy systems. This offers the possibility of rapidly and economically searching out phase equilibria on any combination of metals desired. Objective - to provide theoretical basis for selection of proper ceramic compositions and heat treatments. How work contributes - this work contributes to the selection of thermodynamically stable materials for future AF turbine engines.

The calculational techniques developed for metal alloys will be extended into ceramic systems based on combinations of Cr, Al, Fe, Mg, and oxygen. The lattice stability, compound and solution phase interaction parameters will be evaluated to characterize the stable and metastable phases. Thermochemical data will be estimated from existing experimental phase diagrams where necessary.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Office of Scientific Research NE, Bldg., 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S Dept. of Defense - Air Force

3.0011, HOT PRESSING OF SILICON NITRIDE FOR PROPULSION AND POWER GENERATION SYSTEMS
G.E. GAZZA, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0E4741)

Advanced ceramic synthesis techniques are required to reproducibly fabricate silicon nitride ceramics needed by the Army for critical turbine applications such as nozzles, vanes and rotors. Nozzles and guide vanes with improved resistance to erosion and thermal degradation are required for APU's while the development of turbine materials for primary engine components, e.g., rotors, is required for inlet temperature operation greater than 2300 degrees F to increase engine efficiency and reduce replacement down time. The pacing materials problem area is high-temperature materials under the surface mobility mission area. Thrust - cost reduction via fuel economy.

To synthesize silicon nitride ceramics by using various sintering additives and consolidating by pressure sintering. The use of yttria additives will continue to be explored as well as others, e.g., ceria. Fabrication of simple and complex shapes will be accomplished. Pertinent physical and mechanical properties will be determined up to a temperature of 2700 degrees F.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0012, FABRICATION OF COMPOSITE MATERIAL PROTOTYPE/MIXED FIBER COMPOSITES
B.M. HALPIN, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0D4741)

To provide the basis for increased effectiveness in the use of fiber resin composite materials in Army applications. Depending on the component, weight reductions of 30 to 50 percent can be expected. Composite materials may increase the lifetime and performance of many structures. Standardization of fabrication techniques will be used to increase the reproducibility of the final product. This work unit responds to pacing problem areas 1.6, 2.1, 2.2, 2.4, 9.1, 9.2, 22.5, 25.2, 25.3 and 25.4 of the aircraft portion of the preliminary technical guidance for FY 76. The work unit also responds to improved composite material for missiles and lightweight antitank weapons and for use of organic materials in vehicle application.

Prototypes and specimens representative of items such as missile components, vehicle drive shafts and helicopter spars will be fabricated from high-performance organic fibers, graphic fibers, and glass using new resin systems. In addition to the fibers alone in a matrix, combinations of fibers will be investigated to establish properties of hybrid configurations. The prototype study will be extended beyond filamentary composites to include struc-

tural foams. These foams will be investigated for potential use in many applications formerly employing metal housings, e.g., field radio cases.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0013, COATINGS FOR UPGRADED PERFORMANCE OF GAS TURBINE ALLOYS

M. LEVY, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0B4762)

To develop improved high-temperature coatings for titanium alloys, nickel-base superalloys and columbium alloys for application in the compressor and hot turbine section of gas turbine engines in order to upgrade performance through higher turbine inlet temperatures and increases in time-between-overhaul. Coatings to be developed include: a) a hot salt stress corrosion resistant coating for titanium alloys (e.g., compressor blades, discs, and centrifugal impellers); electrophoretic mcraly coatings for superalloys (e.g., airfoils); and c) improved electrophoretic diffusion coatings for columbium alloys (e.g., blades and vanes). Thrust area is survivability: aircraft and combat vehicles.

To mitigate hot salt stress corrosion of Ti alloys between 500 and 1200 degrees F the principle of applying sacrificial coatings which are electrochemically more electro-negative (active) to the substrate will be explored. Oxidation and sulfidation resistant mcraly coatings for superalloys will be developed utilizing less costly electrophoresis or plasma spraying plus diffusion treatments. Oxidation resistant diffusion coatings based on various combinations of Ti, V, Mo, and Si will be applied to Cb alloys by electrophoresis and pack cementation and will be evaluated.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Res. Center, ATTN - AMXMR-EM, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0014, CHEMICAL CHARACTERIZATION OF SILICON NITRIDE

H.F. PRIEST, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0A4752)

The technical objective is twofold: to determine the impurities present in silicon nitride prepared in a variety of ways, these impurities interact with each other and with the matrix and how silicon nitride can be prepared free of degrading impurities; and to develop rapid, non-destructive 14 MeV neutron and/or high-energy photon activation analysis techniques relevant to the characterization of silicon nitride.

The emphasis will be on silicon nitride for ceramic engine application where the major technical barriers are obtaining starting materials of sufficient purity, producing materials of known composition, theoretical density and sufficient strength, and characterizing the materials and evaluating all parameters to determine if the needed quantum jumps in properties can be obtained. The unique AMMRC 14 MeV activation analysis system will be used to study the oxidation mechanism of silicon nitride and 'sialon'. The chemistry of densification of silicon nitride by pressure sintering as well as hot pressing will be studied in order to optimize the method of preparation. Mass spectrometry, and infrared will be used in this research, which will be carried out at AMMRC, to help characterize the reactions and products.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AMC Materials & Mechanics Res. Ctr., Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0015, FATIGUE BEHAVIOR OF FIBER-REINFORCED COMPOSITES

D.K. ROYLANCE, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0E4749)

To assess the influence on an accelerated environment (high temperature, humidity, and ultraviolet radiation components) on the fatigue lifetime of fiber-reinforced polymer composites, to identify material degradation mechanisms, and to optimize the environmental fatigue resistance of these composites for use in helicopter rotor blades and flight control elements.

Various thermosetting and thermoplastic matrices, reinforced with glass, graphite, and kevlar fibers, will be subjected to cyclic tension - tension fatigue loads while exposed to an accelerated deteriorative environment. Statistical lifetime distributions will be obtained as a function of mean load, and the data correlated with current theories of cumulative damage and crack growth in composites. Materials deterioration mechanisms will be identified by analytical chemical and microscopy techniques, and processing methods will be developed to eliminate or minimize these mechanisms.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0016, ELECTRONIC STRUCTURE AND CHARACTERIZATION OF MATERIALS BY NMR

P.L. SAGALYN, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0C4813)

Lead telluride and lead-tin-telluride are important materials for infrared generation and detection. We will further characterize their band structure to help provide information useful for night vision devices and infrared guidance systems. Beryllium and its alloys with transition metals have important potential applications for missiles, aircraft, and composite materials via NMR for quality assurance and for gaining understanding that will lead to improved materials.

Determination and interpretation of NMR spectra, knight shifts, and spin-lattice relaxation times. The emphasis for FY 76 will be on the interpretation of data we have already taken on be metal, Be-Ni alloys, and on further developing the theory of the NMR measurements on lead salts. If time permits, measurements at liquid-nitrogen temperature and below will be started on PbTe.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0017, POLYURETHANES FOR SPECIAL ARMY APPLICATIONS

N.S. SCHEIDER, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0E4809)

To develop special polyurethanes for transparent armor, adhesive and engineering applications. To understand the relation between composition, structure, and properties of polyurethanes. Major thrusts - survivability, defensive CBR, aircraft and combat vehicles.

The work on polyurethanes for transparent armor will stress the use of diisocyanates capable of yielding color-free and UV stable materials, as well as the use of added stabilizers, to overcome the color formation in experimental polyurethanes which have shown superior ballistic performance. Aromatic diols and other constituents will be evaluated as replacement for MOCA, now banned by OSHA, for the curing of certain classes of polyurethanes in large-scale usage. Studies of the relation between polyurethane composition and low-temperature elastomer performance, toughness and transparency will be carried out by determining the extent of phase segregation and ordering via wide- and low-angle X-ray, infrared and dynamic mechanical methods.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0018, DUPLEX CERAMIC STRUCTURES - IMPROVED REACTION SINTERED SILICON NITRIDE

P. WONG, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0C4794)

The objective of this program is the development of improved reaction sintered silicon nitride materials for future Army

propulsion and/or power generation applications including stationary hot flow path components such as stators and shrouds. The program applies to pacing materials problems in aircraft (turbine components: 14.2, 15.2, 15.7, 15.11 in FY 76 guidance), armored vehicles (combustor, power turbine, and regenerator for 1370 degrees C TiT as well as problems in surface mobility, craft and missile materials. The major thrust is cost reduction via fuel economy.

Development of the infiltration process to produce dense coatings and to densify reaction sintered silicon nitride will continue. Experimental work will be carried on to optimize the infiltration parameters in order to produce suitable samples for oxidation studies.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0019, ARMOR APPLICATIONS OF TEXTURED METALS

A. ZARKADES, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0B4807)

Past studies on the effect of crystallographic preferred orientation and resultant technological breakthroughs have been centered on titanium and its alloys. A continuing material requirement for properties optimization in high-strength steel is still needed. Texturing is important in material which is used in applications where the behavior is determined by material properties in the through thickness direction, e.g., armor plate. Major thrust area is survivability: aircraft and combat vehicles. It is the objective of this program to determine the effect of various processing history parameters and thermal schedules on texture development and control in specially processed steel.

Specially processed vacuum induction melted and electroslag remelted ESR 4340 steel will be examined. Material will be rolled at various temperatures to include effects of processing in single- and two-phase regions followed by quenching. The effect of percent deformation will also be considered. Microstructure and textures will be determined. Plastic anisotropy as measured by the average strain ratio will be established for material of interest.

SUPPORTING AGENCY ADDRESS INFORMATION: AMC Materials & Mechanics Res. Ctr., Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0020, THE RELATION BETWEEN THE CHEMICAL AND PHYSICAL STRUCTURE AND THE MECHANICAL RESPONSE OF POLYMERS

R.P. MORGAN, McDonnell Douglas Astro. Corp., *St. Louis, Missouri* 63166 (DF043420; F44620-76-C-0075)

AF function - advanced aircraft utilize structural components in the form of matrices for composite materials, adhesives and transparencies which are subjected to extreme service environments. Deficiency - a basic understanding of the failure mechanism, and failure mode changes, of polymer glasses is lacking. Objective - this research is to study how the chemical and physical structure of polymeric glasses is related to mechanical response and deterioration in service environments, in particular, moisture and humidity. How work contributes - it is expected that this research will contribute to the understanding which must be established before laboratory simulation tests can be constructed which will predict in-service failures in structural composites.

Two distinct types of epoxies, namely (a) lightly crosslinked systems, and (b) highly crosslinked, void-dependent systems, will be studied to determine the effects of structure, morphology and voids on the mechanical properties and their relation to failure modes by several current and advanced characterization techniques. The effect of cyclic heat and moisture on the microvoid characteristics and mechanical properties will be studied. The tensile and compressive mechanical properties will be monitored as a function of temperature and strain rate to elucidate the size of the entities involved in the flow processes and a model will be developed to correlate structure to failure modes and mechanical response.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Office of Scientific Research NC, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0021, CATALYTIC COMBUSTION FUEL/AIR CARBURETOR

G. ROFFE, General Applied Sc. Labs. Inc., *Westbury, New York* 11590 (DF459550; F33615-76-C-2070)

To obtain a fuel/air carburetion system for use as part of the in- house evaluation of catalytic combustion.

A contractural effort to design, fabricate and characterize carburetors was initiated. Specified performance (degree of fuel vaporization, composition and velocity uniformity) and avoidance of ignition within carburetor must be demonstrated.

ADDENDA: SUPPORTING AGENCY ADDRESS is: AF Aero-Propulsion Laboratory SFF, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0022, EFFECT OF PREFERRED ORIENTATION AND RELATED METALLURGICAL PARAMETERS ON MECHANICAL PROPERTIES OF HIGH-HARDNESS STEELS (ABBREV)

H. HSUN, U.S. Steel Corporation, *Monroeville, Pennsylvania* 15146 (DA0E4769; DAAG46-73-C-0244)

Three primary metallurgical parameters which can alter the ballistic performance of armor steel are: crystallographic texture - amount of retained austenite - and austentite-grain size. However, since these parameters can vary simultaneously, their relative importance has not been assessed. The objective, therefore, is to control the metallurgical variables and determine the individual effects of each on the ballistic properties of high-hardness steel armor. Major thrust area is aircraft and combat vehicle survivability.

A medium carbon 5Ni-Si-Mo-Cu steel will be thermomechanically treated to develop varying textures retained austenite- and austenite- grain size in 1/2 inch thick plate. Ballistic performance will be determined using 50-caliber armor piercing projectiles and 0 degree obliquity. Room temperature mechanical properties will be obtained along with pole figures to fully describe preferred orientation of the crystallites. Comparison of ballistic results will be made to determine if any of the metallurgical parameters can significantly improve the ballistic properties of steel armor.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Res. Ctr., ATTN-AMXMR-EM, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0023, PROPERTIES OF NEW BRASS-LIKE MAGNETIC COMPOUNDS 6079-MS

A. WOLD, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DA0B9119; DA-ARO(D)-31-124-73-G13)

To systematically search for new magnetic compounds of the transition metals, the persistent theme being the discovery of the relationship between structure and magnetic properties. The class of systems under study includes compounds whose properties (e.g., ferromagnetism, magnetic susceptibility, electric resistivity) change abruptly with temperature, so that materials of promptly recognizable utility may be discovered (e.g., for switching control). The existing need for magnetic materials for infrared applications at wavelengths such that fluorides and oxides are inadequate creates further practical interest in the work.

1) Preparation and study of series of oxy-, thio-, and selenocompounds. 2) Preparation and investigation of substituted transition metal phosphides having structures related to that of pyrite, and analogous compounds with other anions. 3) Extension of work on the system, Fe sub 2 as sub X P sub 1-X, to compounds wherein X exceeds 0.5, and to other series in which the substituent element may be Sb, B, S, or Se. 4) Investigation of the structural basis for the compositional limits observed as CuFeS sub 2 is modified to Cu sub 1-X Fe sub 1 plus X S sub 2-delta, and a search for the electrical and magnetic significance thereof.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Rsch. Triangle Pk, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0024, CHEMICAL REACTIONS IN SHOCK WAVES 12637-C

W. GARDINER, Univ. of Texas, School of Arts & Sciences, *Austin, Texas* 78712 (DA0A5579; DAAG29 75 G0061)

To determine the high-temperature combustion chemistry of hydrocarbons in an effort to gain insight into the process of ignition and to investigate the chemical kinetics of flame lasers including the CS sub 2 - O sub 2 system. Relevance - research on hydrocarbon chemistry has relevance to Army programs in ignition and combustion. The results have potential application for the improvement of GDL technology. Results form work on the CS sub 2 - O sub 2 system are directly relevant to the chemical laser studies in process at MICOM.

Elementary reactions in hydrocarbon combustion will be investigated using shock tube techniques. Concentrations will be measured by tunable IR laser absorption. The mechanism of oxidation will be investigated using computer modeling methods. Reflected shock waves will be utilized in studying the kinetics of the CS sub 2 - O sub 2 system.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0025, A THEORETICAL STUDY OF THE CHEMISTRY OF THE UPPER ATMOSPHERE

T.J. OBRIEN, Texas Technological University, School of Arts & Sciences, *Lubbock, Texas* 79409 (D-459)

A Diatomics-in-Molecules surface to describe the process O ion plus O sub 2 yields O sub 2 plus O is being constructed. This will be used for a trajectory study of this important atmospheric process. Diabatic behavior appears to be important only for high vibrational excitation. Thus the process should be governed by an adiabatic surface.

The finite-element method, which was developed by engineers to solve multi-dimensional problems, is being applied to some quantum mechanical problems. The method has proved much more successful in engineering problems than the finite-difference method. However, no applications of this method to the Schrodinger equation have been published.

SUPPORTED BY Robert A. Welch Found. - Houston, Texas

3.0026, LUBRICATION REQUIREMENTS FOR MILITARY POWER-TRAIN SYSTEMS

S.J. LESTZ, Southwest Research Institute, *San Antonio, Texas* 78228 (DA0M3662; DAAG53 76 C 0003)

Investigate the mechanisms of lubricant degradation, deposit formation, and wear characteristics for current and future military automotive, engineer, aviation and power-train systems.

Selected multi-cylinder engines, special single-cylinder engines and/or gear systems and chemical analytical methods are used or developed as required to study lubrication mechanism problems, to check laboratory/field correlation of lubricant compatibiltiy, or to develop laboratory techniques which relate to field performance.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MERADCOM Fuels & Lubes Division, Ft. Belvoir, Va. 22060

SUPPORTED BY U.S. Dept. of Defense - Army

3.0027, ALTERNATE ENERGY SOURCES FOR ARMY SURFACE AND AIR POWER PLANTS

R.D. QUILLIAN, Southwest Research Institute, *San Antonio, Texas* 78228 (DA0M3659; DAAG53 76 C 0003)

Based on world liquid hydrocarbon fuel shortages, evaluate and assess suitability of using alternate, emergency and non-specification fuels in military ground-powered equipment.

Hardware components, single-cylinder and multi-cylinder engines will be used to define combustion properties of crude oils, blends of different spec fuels, and the addition of fuel extender (water induction), in order to establish feasibility of broadening hydrocarbon logistical base.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MERADCOM Fuels & Lubes Division, Ft. Belvoir, Va. 22060

SUPPORTED BY U.S. Dept. of Defense - Army

3.0028, EXPERIMENTAL STRAIN ANALYSIS

C.A. WALKER, Univ. of Strathclyde, *Glasgow, Scotland, United Kingdom* (DF138670; AF-AFOSR-3007-76)

Knowledge and understanding concerning the fatigue behavior of composite materials is necessary if these materials are to be used safely and efficiently in aerospace structures. The purpose of this effort is to perform experimental strain analysis on composite materials and to investigate the fatigue behavior of notched composite specimens. Payoff is the transitioning of composite technology into the area of aircraft structures. Advantages include light weight, low cost and more versatile structures.

The optecord surface stain analysis technique will be employed to investigate the stain field around nucleating and growing cracks in composite specimens and structures. Analysis will be performed to gain a better understanding of the fatigue behavior.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Flight Dynamics Laboratory FBEC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0029, CRITICAL BEHAVIOR IN MANY-BODY SYSTEMS

C. DOMB, Univ. of London, *London, England, United Kingdom* (DA0B9474; DAERO 76 G0003)

Fundamental work applicable to magnetism, polymers, catalysis, etc. Specific application to Army interests in ferroelectrics, ferrofluids, and processes involving phase transitions.

It is proposed to extend the series expansions which have been derived for the Isling model so as to obtain a more accurate picture of behaviour in the critical region. The results will be applied to ferromagnetism, antiferromagnetism, and order-disorder transitions, attention being paid to the scaling hypothesis and some apparent anomalies. A particular investigation will be undertaken of dilute magnets and their critical behaviour. The same techniques will be used to explore the influence of excluded volume on the shape and size of polymer chains and their adsorption at a surface.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Research & Standardization Group (Europe), Box 15, FPO, N.Y. 09510

SUPPORTED BY U.S. Dept. of Defense - Army

3.0030, PARTIAL-WAVE METHODS IN MOLECULAR ELECTRONIC STRUCTURE CALCULATIONS

E.A. MCCULLOUGH, Utah State University, School of Science, *Logan, Utah* 84321 (CHE76-08768)

One goal of molecular quantum mechanics research is the quantitative prediction of molecular properties. In light of contemporary scientific problems involving molecules in the upper atmosphere or interstellar space, this goal increases greatly in importance, for the molecular species found in these environments are difficult to study by experimental methods. Hence, theory can and must make significant contributions in these areas. Despite recent advances in molecular quantum mechanics, there remains a group of molecular properties which are difficult to compute accurately. This is because most of the current techniques rely on a single computational method which is not well suited to the description of these properties. Recently, a new method involving partial-wave expansions and numerical orbitals has been developed. The method has been implemented successfully for diatomic molecules and preliminary results have shown that the present method works very well at the first level of approximation (restricted Hartree-Fock). The present research project will extend this new method to higher levels of approximation in order to fully develop this method of computing accurate molecular properties.

SUPPORTED BY U.S. Natl. Science Foundation

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, DEVELOPMENT OF MODELS FOR THE INFRARED RADIATION FROM EXHAUST PLUMES
K. HARWELL, Auburn University, School of Engineering, *Auburn, Alabama* 36830 (DA0E1412; DAAH01-75-C-0121)

This work is designed to develop numerical computer models for describing both the gas dynamics and infrared radiation emitted from subsonic and supersonic turbojet and rocket exhaust plumes. Efforts will also include characterization of imbedded shock waves, Mach discs and the turbulent mixing layer.

The appropriate physical, thermodynamic and chemical equations describing the gas dynamics will be solved with suitable approximations, where necessary, to achieve a tractable numerical solution on a high- speed digital computer. These results will be combined with existing and upgraded versions of gaseous radiation models to yield plume emission characteristics. Results will be compared to experimental data generated by subscale and full-scale plume generators.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MICOM Advanced Sensors Directorate, MRD & EL, Redstone AR, Al. 35809

SUPPORTED BY U.S. Dept. of Defense - Army

4.0002, ANALYSIS OF FLIGHT VERIFICATION OF ROCKET PLUME EFFECTS
J.H. HENDERSON, U.S. Army, Missile Res. Dev. & Eng. Lab., *Huntsville, Alabama* 35809 (DA0F1014)

The objective of this work unit is the verification that rocket jet plume effects on missile aerodynamics during flight can be properly simulated (modeled) during wind-tunnel tests of longitudinal aerodynamic characteristics. The primary goal is improvement in the correlation between plume characteristics and effects on longitudinal stability. This improvement is expected to lead to better design control of the variation of pitching moment with Mach number (burn time) resulting in reduced wind sensitivity of free-rockets.

In addition to flight tests either sled tests or wind-tunnel tests will be made to verify rocket plume effects. Both pressure and force measurements will be made. Analytical studies of rocket plumes will also be made.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MICOM Aeroballistics Directorate, MRD & E Lab., US Army Missile Command, Redstone Arsenal, Al. 35809

SUPPORTED BY U.S. Dept. of Defense - Army

4.0003, FREE-FLIGHT ROCKET TECHNOLOGY
S. SMITH, U.S. Army, Propulsion Directorate, *Huntsville, Alabama* 35809 (DA0E1319)

To improve the accuracy of surface-to-surface free-flight rockets to reduce the cost of surface-to-surface free-flight rockets.

The technology developed in FY 75 will be applied in a demonstration program. An adjustable nozzle will be designed, fabricated and tested, and then incorporated in the Zuni rocket motor. Impulse reproducibility technology will be combined in a motor design and this motor fired. Two thrust level motor designs will be fabricated and used in launcher experiments.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MICOM Free Flight Rocket Technology Office, US Army Missile Command, AMSMI-RX, Redstone Arsenal, Al. 35809

SUPPORTED BY U.S. Dept. of Defense - Army

4.0004, FLUIDIC SUPPORTING TECHNOLOGY/REAL-TIME RELIABILITY
D.J. SCHAFFER, Signal Companies Incorporated, *Phoenix, Arizona* 85034 (DA0D5755; DAAG39-72-C-0092)

To obtain real-time reliability for fluidic systems.

Failures and other pertinent information from laboratory and experimental flight tests will be recoded by the contractor for a number of fluidic systems manufactured by him. Active monitoring of fielded fluididc systems will also be included. The work is coordinated through the government Fluidics Coordination Group which supplements the effort and assists in planning.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Harry Diamond Lab., 2800 Powder Mill Road, Adelphi, Md. 20783

SUPPORTED BY U.S. Dept. of Defense - Army

4.0005, PHOTO-EFFECTS OF SI MOSFETS
L. FORBES, Univ. of Arkansas, School of Engineering, *Fayetteville, Arkansas* 72701 (DF900220; F19628-75-C-0071)

AF function - infrared imaging and target tracking. Deficiency - lack of detectors suitable for applications employing large-scale arrays. Research - investigation of Ga, In, Au impurities in silicon. How research contributes - the fundamental behavior of these impurities in silicon and their infrared sensing characteristics in MOSFET structures will permit the fabrication of suitable detector arrays.

Design and fabricate gold, indium, and gallium doped silicon MOSFETs and measure their photo-response in the up to 3.2 micron, 3 to 5 micron, and 5 to 14 micron regions, respectively.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Cambridge Research Laboratories LQ, L. G. Hanscom AFB, Bedford, Mass. 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0006, SOS FILM STUDIES
UNKNOWN, Rockwell International Corp., *Anaheim, California* 92803 (DF900660; F19628-75-C-0108)

AF function - radiation hardness of Air Force space and missile systems. Deficiency or opportunity - current nuclear hardness requirements for semiconductor devices are not being met. Objective - to investigate the defects and impurities in silicon on sapphire material which reduces the radiation hardness. How research contributes - the research will contribute to the understanding of the types and concentrations of defects and impurities in silicon on sapphire and how they relate to the radiation hardness of SOS devices. The results of this research will contribute to the development of a radiation-hardened technology for use in Air Force space and missile systems.

This program will investigate the sapphire substrate and silicon film to determine defect and impurity concentrations and distributions and will characterize the effects of such imperfections on electrical and radiation hardness parameters of devices fabricated in this material. Techniques for defect studies such as X-ray diffraction, minority carrier lifetime measurements, ion backscattering, and other appropriate techniques will be investigated. Samples of silicon on sapphire material will be studied using these techniques to identify types of defects and impurities and their concentrations. Devices such as MOS capacitors will be fabricated on these samples and the radiation hardness will be correlated with the defect and impurity studies.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0007, TURBULENT PLASMA HEATING USING ELECTRON BEAMS AND LASERS
J. DEGROUT, Univ. of California, School of Letters & Science, *Davis, California* 95616 (AFOSR-72-22 090C)

DESCRIPTION: The purpose of this project is to find efficient ways to heat plasmas using turbulent plasma processors. This work involves modeling experiments, computer simulation calculations, and analysis. So far parametric processes have been investigated for laser plasma heating. The detrimental high-energy electrons have been measured.

ADDENDA: Estimated calendar year funding reported as 1975 $130,000. Also supported by: Lawrence Livermore Laboratory.

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0008, CALCULATION OF SEPARATED FLOW ABOUT A GENERAL BODY IN A NON-UNIFORM ONSET FLOW 13690-EX

J.L. HESS, McDonnell Douglas Corporation, *Long Beach, California* 90808 (DA0E9040; DAAG29 76 C 0021)

To analyze the flow about a general three-dimensional body immersed in a non-uniform onset flow with the aim of predicting the aerodynamic pressures and forces acting on the body. The proposed investigation is directly relevant to the problems of missile separation on helicopters being studied at both MICOM and AMRDL-Eustis Directorate and is also relevant to the problem of gusts and round-to-round and launcher-to- round interferences on missiles.

Existing general surface singularity methods for calculating potential flow with uniform onset flow will be generalized to account for non-uniform onset flow conditions and possibilities of separated flow regions. Separated flow regions will be treated by Eiyher wake shape being input to calculation or having wake shape determined as part of an iterative computation.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0009, INVESTIGATION OF SOLID-SOLID REACTIONS 13514-MS

T.J. MAGEE, Stanford Research Institute, *Menlo Park, California* 94025 (DA0E9116; DAAG29 76 C 0036)

To characterize the kinetics and mechanisms of solid-solid reactions in gold-silicon, aluminum-silicon, and silver-silicon systems. Relevance - the research is relevant to silicon device fabrication technology. A number of programs at NVL involve the development of silicon charge-coupled devices for imaging and signal-processing applications, as well as Ohmic or nearly Ohmic silicon devices for cryogenic operation. ECOM and HDL state that the proposal is relevant to a broad spectrum of semiconductor devices, especially the reliability of military devices.

The program will include determination of the energies of activation and the mechanisms of diffusion and characterization of the microstructural and electrical features of the above systems, to include a study of the effects of various thermal treatments.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0010, RESEARCH ON NEW APPROACHES TO OPTICAL SYSTEMS FOR INERTIAL ROTATION SENSING

M. CHODOROW, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (DF044420; AF-AFOSR-3070-76)

AF function - navigation, guidance and control of aircraft, spacecraft and missiles require sensors of angular rotation rate in inertial space. Deficiency - the coming use of ring lasers in platform and strapdown systems poses problems of cost, size and reliability. Objective - the intrinsic limitations of the ring laser are to be avoided by new approaches to angular rate sensing using optical means. How work contributes - this research should lead to devices which are free from lock-in and bias effects usually encountered in conventional laser gyros, while still allowing rotation sensing with high sensitivity and accuracy as well as ready adaptation to specific requirements such as size reduction, cost decrease or sensitivity increase, by utilization of different operational modes and adaptation to vehicle geometry.

The new approaches are based on the Sagnac effect as in the ring laser, but involve modification to the cfassical Sagnac procedure consisting of use of multi-turn loops, modulation of the external optical source, use of inertial amplification in the loop and use of photodetector phase comparators for read-out. Optical fiber waveguides appear promising for constructing multi-turn rotation sensing loops for navigation of vehicles having unique geometrical advantages. Accuracies of the order of 10 sup-4 deg/hour are in prospect for measuring rotation of large vehicles. Multiple-turn paths using off-axis confocal mirrors provide an alternative, which would be viable on applications involving small-diameter paths where mirror systems would be acceptable. This first phase of the investigation will concentrate on proving the principles of the new approach using only passive loops.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Office of Scientific Research NE, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0011, STUDY OF INFRARED UPCONVERSION TUNABLE LASERS

S. HARRIS, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DF900300; F19628-75-C-0046)

AF function - airborne reconnaissance, communications, surveillance. Deficiency - upconversion techniques and tunable lasers for above are inefficient. Objective - perform research on a new efficient upconversion technique and a new type of tunable lasers. How research contributes - improve conversion efficiency from infrared to visible and provide new tunable, coherent sources for above AF functions. The objective of the contract is to study a new, very efficient infrared upconversion technique utilizing resonantly two- photon pumped metal vapors. In particular, to search for coincidences between two-photon absorption lines in suitable metal vapors and laser lines. Further, to investigate the various pertinent parameters with a view towards optimizing the conversion efficiency. Finally, the possibility of constructing a tunable, optically pumped sodium-xenon excimer laser will be explored.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0012, ELECTRON BEAM SEMICONDUCTOR (EBS) L-BAND AMPLIFIER

B. BELL, Watkins Johnson Company, *Palo Alto, California* 94304 (DA0D2690; DAAB07-75-C-1329)

To develop a low-cost EBS device capable of amplifying a narrow- bandwidth, pulsed RF signal at L-band with high gain, high efficiency and long life. The intended use is for IFF systems.

The design approach involves the use of a grid-controlled amplifier with a reverse-biased EBS diode mounted on the plate of the tube to receive the density-modulated electron beam. The incident modulated beam induces a proportional modulation of the diode current, and the output RF pulses are coupled directly into an external resonant transmission line which can be used to tune and impedance-match the diode.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Electronics Tech. & Devices Lab., (DRSEL-TL-BS), Ft. Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

4.0013, GAAS TECHNOLOGY STUDY

A.L. JOSEPH, Rockwell International Corp., *Thousand Oaks, California* 91360 (DF900060; F19628-75-C-0113)

AF function - improved missile and satellite systems. Deficiency or opportunity - lack of solid-state devices that operate at X-band frequencies. Objective - investigation of the important technological problems affecting GaAs device fabrication. How research contributes - fundamental materials problems associated with device fabrication in GaAs will be investigated. The solution of these problems will permit the increase of both yield and performance of GaAs, high-frequency devices.

Devices which best delineate key material and processing problems will be fabricated, and used as the primary tools of analysis. For this purpose, three main devices that have critical material and processing problems are: the Schottky barrier FET, the Impatt diode microwave source and the LSA diode. Furthermore, all the analysis capabilities of the Science Center and the four associated universities will be made use of where necessary.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0014, EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE CONTROLLABLE TWIST ROTOR (CTR SYSTEM)

A.L. LEMNOIS, Kaman Aerospace Corporation, *Bloomfield, Connecticut* 06002 (DA0C4093; DAAJ02-72-C-0092)

The technical objective of the program is to experimentally evaluate the potential aeroelastic and performance benefits of the controllable twist rotor (CTR). The CTR is a rotor concept which uses torsionally soft blades in conjunction with a mechanical blade root control and aerodynamic blade tip control to produce blade twist control.

The CTR concept will be carefully analyzed and a FU66 (6) model system will be designed and built. This model, which will be approximately the size of a CH-34 rotor system, will be tested on the Kaman Whirl Tower to establish basic stability and performance. The model will then be shipped to NASA-Ames where it will be tested in the 40-by-80-foot tunnel. The results will be carefully evaluated to determine the aeroelastic and performance characteristics of the CTR versus more conventional systems.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R and D Lab., Eustis Directorate, Fort Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

4.0015, DESIGN, FABRICATION AND TEST OF ADVANCED DEVELOPMENT ROLLER GEAR TRANSMISSION FOR ARMY AIRCRAFT

G. GARDNER, United Aircraft Corporation, *Stratford, Connecticut* 06497 (DA0B4060; DAAJ02-69-C-0042)

Conduct a program to perform experimental, developmental, or research work to design, fabricate and test a roller gear transmission system in an S-61 type helicopter.

The contractor will perform: a preliminary design trade-off study and a detail design of all components associated with the installation of the roller gear transmission into an S-61 helicopter; manufacture eight (8) roller gear units with spares to support test program; conduct 200-hour bench test; conduct 50-hour aircraft tiedown test; conduct a 1,000-hour reliability program including overload testing; prepare six (6) individual final reports for publication as the finished product. The 25-hour FLT demonstration was recently deleted from the scope of work.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

4.0016, IONIC TRANSPORT AND COLLISION PROCESSES IN LASER GASES 12134-P

E.W. MCDANIEL, Georgia Inst. of Technology, School of Physics, *Atlanta, Georgia* 30332 (DA0E8914; DAHC04-74-G-0192)

To obtain data useful in the calculation of the rate at which free electrons are lost in electrical discharge and electron beam CO2 lasers. This research will provide reaction rate data for models of CO2 electric laser action being designed by the Army High-energy Laser Project Office at Redstone Arsenal.

Drift-tube mass-spectrometic techniques will be employed in obtaining the following data: relative abundances of the various species of positive and negative ions in CO2 and laser mixtures as a function of the gas pressure and E/N; measurement of electron-ion recombination and loss of negative ions by ion-ion recombination; measurement of drift velocities and diffusion coefficents of positive and negative ions in CO2 and CO2 mixtures as a function of E/N.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0017, CONTROL AND SUPPRESSION OF SWIRLING AND SECONDARY FLOWS IN CONFINED STREAMS 12290-E

H.M. NAGIB, Illinois Inst. of Technology, School of Engineering, *Chicago, Illinois* 60616 (DA0D9293; DAHC04-74-G-0160)

To conduct an in-depth experimental investigation of techniques for controlling and suppressing mean and unsteady characteristics of swirling and secondary flows in confined streams. Relevance - the improvement of the quality of wind-tunnel flows is extremely relevant to experimental investigations carried out by BRL (as well as AMRDL-Langley and AMRDL-Ames) since BRL investigators have observed that swirl can persist even into the test section of their wind tunnels. In addition, this research project is relevant to defining wind-tunnel flows with swirl applicable to some Army problems for spinning projectiles.

Work will consist of developing procedures for such control and extracting from the empirical observations of fine basic test flows general concepts which the design and test engineers can adapt for 'tailoring and manipulating' their own special flows with different rotational characteristics.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AMC Army Rsch. Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0018, INTERNAL & EXTERNAL BALLISTICS OF MISSILES WITH SPECIAL CONSIDERATION OF JET PLUMES INTERFERENCE EFFECTS DURING LAUNCH & FREE FLIGHT PHASES

H.H. KORST, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DA0E9089; DAAG29 76 G0209)

To conduct a comprehensive research program dealing with aerodynamic interference problems encountered during various phases of in-tube propulsive burning and ballistic flight trajectory of rockets. This research is directly relevant to the problem of estimating jet plume effects on performance, stability and control of high-acceleration rockets and missiles. Such problems have been identified as high- priority advanced technology areas in the MICOM missile plan. In addition, it is relevant to the research activities at BRL in launch and transitional ballistics.

This program shall include theoretical analysis, computer program development, mathematical modeling, and selected experimentation aimed at establishing the merits of analytical and modeling concepts for jet plume-launcher wall interference, blow-back at breach, muzzle blast, and jet plume-slipstream interference.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0019, BALLISTIC SIMULATOR OF TESTING SOLID PROPELLANT GRAINS

H. KRIER, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DAAA 21-C-75-0006)

Tests were conducted on a laboratory ballistic simulator, called the Dynagun, to determine whether or not it could accurately duplicate the dynamic combustion response of small solid-propellant grains. The Dynagun, designed and built at the University of Illinois, is essentially a scaled-down gun using an inertial mass with a sliding pressure seal which is accelerated by high-pressure gases from the burning propellant. Research is in progress to calculate indirectly the dynamic burning rate from known pressure and displacement data.

SUPPORTED BY U.S. Dept. of Defense - Army

4.0020, MACROSCOPIC DESCRIPTION OF LASER MATTER

I.R. SENITZKY, Israel Inst. of Technology, *Haifa, Israel* (DA0C9358; DAERO75G0012)

To develop a macroscopic, classical description for a collection of multilevel atomic systems which takes into account all the levels, or frequencies (radiative and nonradiative), pertinent to laser operation. Such a description will facilitate laser analysis, design, and, possibly, improvement.

The research approach is based on the well-founded assumption that a multilevel system can be treated as a multilevel 'angular momentum' oscillator and that, consequently, a collection of the multilevel systems can be described by the 'vector ad-

dition' of the angular momentum oscillator. The macroscopic behavior of a system of multilevel molecules is then obtained by taking the limit of large total angular momentum number.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Research & Standardization Group (Europe), Box 15, FPO, N.Y. 09510

SUPPORTED BY U.S. Dept. of Defense - Army

4.0021, DEVELOPMENT OF MISSILE OPTICAL CONTROL LINK

W.H. CULVER, Optelecom Incorporated, *Gaithersburg, Maryland* 20760 (DA0F1059; DAOAH01 76 C 0341Z)

The objective of this work unit is for the development and demonstration of an optical video control link utilizing an optical fiber.

Efforts will be expended in developing a three-dimensional analytical model of fiber payout process, mechanical experimentation to determine payout system characteristics, investigating optical/mechanical properties of a number of fibers, and analysis of these theoretical and experimental investigations.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MICOM Aeroballistics Directorate, AMRD & EL, Redstone Arsenal, Al. 35809

SUPPORTED BY U.S. Dept. of Defense - Army

4.0022, LOW-ENERGY LASERS - ION-HOST INTERACTIONS

C.A. MORRISON, U.S. Army, Harry Diamond Laboratories, *Hyattsville, Maryland* 20783 (DA0E5696)

The object of this task is to advance a systematic approach for selecting solid-state laser materials that offer promise as new lasers with predetermined characteristics and for improving existing solid- state lasers and components. Also, those areas of quantum optical technology that may contribute toward the development of new and improved military laser systems are to be investigated.

A parametrized theory of crystal fields has been developed that gives agreement between derived and phenomenological, even-fold crystal- field parameters which determine energy levels and wave functions. The parametrized theory also predicts the odd-fold fields which are needed for intensity calculations and are very difficult to obtain by any other method. The necessary computer programs shall be incorporated with this new theory so that laser-related properties of selected materials can be calculated, and thus, the most promising can be selected for further study.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Harry Diamond Lab., 2800 Powder Mill Road, Adelphi, Md. 20783

SUPPORTED BY U.S. Dept. of Defense - Army

4.0023, SEMICONDUCTOR DEVICE MATERIALS AND STRUCTURES

J.K. KENNEDY, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF901040)

AF function - communications. Deficiency - materials limit the fabrication of suitable devices. Objective - 1) to develop a capability for the preparation of improved bulk gallium arsenide and indium phosphide crystals for use as substrates in microwave devices. 2) To determine the epitaxial growth parameters necessary for the preparation of epitaxial structures for high-frequency and high-power FET's, infrared detectors, radiation damage and ion implantation studies. How research contributes - gallium arsenide and indium phosphide microwave devices have enormous potential for the Air Force, especially in terms of radar and communication systems. High cost and a lack of reliability and reproducibility are prime deterrents to their incorporation in systems. One of the main reasons for high cost, unreliability, and non reproducibility is poor substrate quality. Work to be conducted should lead to improved substrate materials for device fabrication.

Our approach assumes that the underlying reason for the poor electrical properties of commercial gallium arsenide is impurity incorporation from the growth apparatus. Using a modified liquid encapsulation Czochralski technique we will study the effect of varying crucible materials on the electrical properties of the gallium arsenide grown. The growth of indium phosphide will be studied concurrently. Using a hydride system we will grow high-resistivity layers of gallium arsenide. We will evaluate these layers as buffer layers for FET fabrication and also determine the growth parameters necessary to provide the doping and thickness control necessary for growth of the active layers of an FET structure.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0024, /U/ SPACE RADIATION EFFECTS ON INSULATORS USED IN ARTIFICIAL EARTH SATELLITES

J.A. WALL, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF900980)

AF function - communications. Deficiency - communications satellites (DSCS) have displayed erratic electronic behavior soon after being placed in orbit. It has been determined that at least some of the observed malfunctions could be due to electrical breakdown in insulating materials caused by the effect of electrons present in the region of satellite orbits. Objective - the objective of this work is to provide fundamental information on the effects of electrons, with energies corresponding to those encountered in the orbital region of the satellites, on insulating materials used in communications satellites. How research contributes - the information to be obtained will make possible improved satellite designs that minimize malfunctions due to space-radiation-induced electrical breakdown.

There are three electron-insulator interaction phenomena relating to electrical breakdown that will be investigated. These phenomena are induced conductivity, secondary electron emission, and injected charge distribution. Literature searches will be performed in each of these areas to determine the current availability of data and its relevance to the satellite charging problem. Where data is needed, experiments will be performed to obtain the required information. These experiments will consist basically of irradiating the insulating materials with electrons of appropriate energies in a clean, oil-free vacuum and measuring the induced conductivity and secondary electron emission. Injected charge distribution will be determined theoretically. The information generated by these investigations will be combined to select and test insulator-conductor combinations that will minimize the probability of space-radiation-induced electrical breakdown.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0025, SIGNAL PROCESSING AND LASER UPGRADING OF REMOTE RAMAN INSTRUMENT

S.M. KLAINER, Block Engineering Incorporated, *Cambridge, Massachusetts* 02139 (DA0E0982; DAAA15 C 0164)

To construct, test and install a set of electronics capable of real-time readout of backscatter Raman radiation as a function of range. To construct a modified Q-switch assembly for the spacerays laser presently used in the system.

A three-channel set of electronics will be constructed with analog to digital circuitry and digital logic capable of performing integration and subtraction. The output will be via oscilloscope. The Q-switch assembly will use components of a Korad laser presently owned by the government. The components will be removed, mounted in a standard rack mount, and installed in the spacerays laser electronics rack.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ARMCOM, Edgewood Arsenal APG, Md. 21010

SUPPORTED BY U.S. Dept. of Defense - Army

4.0026, TECHNOLOGY AND PHYSICS OF INFRARED POINT-CONTACT DIODES

A. JAVAN, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (DF901510; F19628-74-C-0182)

AF function - surveillance, communication, reconnaissance. Deficiency or opportunity - infrared detectors are slow and need cooling. Objective - perform research and exploratory development on detection and generation of IR radiation utilizing a point-contact diode. How research contributes - the point-contact diode is a fast, room-temperature IR detector with potential applications for surveillance, communications and reconnaissance. Approach - the research will be concentrated in two main areas. Applications of the mechanically contacted junction will be explored in the areas of parametric generation and detection of infrared radiation. These studies should lead to a better understanding of the physical processes determining the diode characteristics and give information needed for the construction of a tunable infrared radiometer. The second area of research will be to investigate the possibilities offered by printed point-contact junctions and the applications of a variety of coherent phased-array configurations.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0027, INFLUENCE OF SECONDARY FLOWS AND ROTATIONAL EFFECTS ON TURBINE ENDWALL AND SHROUD HEAT TRANSFER

J.F. LOUIS, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF459640; F33615-76-C-2018)

To quantitatively identify heat transfer mechanisms present in high-performance turbine blade passages. To generate and test new film cooling configurations and provide useful turbine cooling design data for future systems. Identification of the factors controlling heat transfer mechanisms will result in increased component life and better gas turbine performance.

Investigate analytically and experimentally the influence of secondary flows arising from distorted pressure and temperature profiles on heat transfer to turbine endwall and shroud. Investigate the combined effects of secondary and centrifugal effects on shroud. Use results to design optimum cooling configuration of wall and shroud.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Aero-Propulsion Laboratory TBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0028, STUDY OF SURFACE FATIGUE WEAR BY EXOELECTRON EMISSION 11889-E

E. RABINOWICZ, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DA0E8936; DAAG29 74 C 0028)

To investigate stimulated exoelectron emission as a technique for studying rolling contact fatigue. This phenomenon of wear is vital to Army interests in a myriad of situations. For example, in all machines or devices making use of ball or roller bearings, wear is a critical factor in performance. Excessive wear of an inexpensive element can cause operation failure in a very costly and vital machine as, for example, in a helicopter rotor or a radar scanning device.

Rolling contact life tests will be conducted in a standard 4-ball rig, and at intervals the top ball (the one which generally fails in rolling conact fatigue) and the exoelectron emission will be measured. When failure occurs, the failure time and location will be compared with previously observed exoelectron emission.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0029, ATMOSPHERIC DENSITY MEASUREMENT IN THE MIDDLE ATMOSPHERE 13870-GSX

F.B. SELLERS, Parametrics Incoroporated, *Waltham, Massachusetts* 02154 (DA0E9099; DAAG29 76 C 0041)

To design and fabricate an instrument utilizing beta radiation to measure atmospheric density to an elevation of 100 kilometers. Precise spatial and temporal variations in density are very important parameters in calculations for reentry of missiles in the atmosphere. An instrument capable of making the necessary measurements is proposed. The proposal also has broader relevance as a unique approach to direct sensing of atmosphere density.

The first phase of the research involves investigation of satisfactory beta radiation sources and detection. Space simulation chambers will be used to measure and calculate the density response to beta radiation. Based on the results, a density sonde will be designed and fabricated in the second phase of the work.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0030, LASER PROPAGATION PHENOMENA

E. COLLETT, U.S. Army, Electronic Warfare Laboratory, *Red Bank, New Jersey* 07703 (DA0D3052)

The objective of the present research is to provide an analytical base to describe the propagation of low- and high-power laser beams propagating in a turbulent atmosphere.

Specifically, analytical and numerical techniques will be applied to the nonlinear equations of fluid dynamics via the normalized repeated cascade method under varying atmospheric, solar, and terrain conditions.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Electronic Warfare Lab., (DRDEL-WL-A), Ft. Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

4.0031, DIGITAL/MODULAR AVIONICS (COMMUNICATIONS)

A.W. LINDBERG, U.S. Army, Avionics Laboratory, *Red Bank, New Jersey* 07703 (DA0D2811)

The objective of this program is to provide communications system support to the main digital modular avionics program which will design and breadboard a core Army avionics system using digital modular techniques. The elements of this core system will consist of communications, navigation, IFF transponder, and general-purpose day/night display components. Specialized support will be provided for the communications equipment elements in the form of electrical and digital interfacing.

The approach will consist of selecting suitable communications equipment for the core system, establishing the interface standards and design criteria between the core system and communications subsystem, and providing support for bench and flight tests of the entire core avionics system.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Avionics Lab., US Army Electronics Command, Ft. Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

4.0032, ADVANCED AVIONIC SYSTEMS ANALYSIS

L. YOUNGBLOOD, U.S. Army, Avionics Laboratory, *Red Bank, New Jersey* 07703 (DA0C3431)

Development of the software necessary for integration of advanced tactical avionics systems and participation in development of government/industry systems integration standards.

To participate in triservice/industry efforts to develop standards for advanced tactical avionic systems (these include standards for avionic software and multiplex hardware). To apply existing software operating systems (e.g., SKC-2000 assembly language, INTEL 8080 assembly language) to the design of software addressing current Army exploratory development problems. To perform the systems analysis necessary to support these efforts.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Avionics Laboratory AMSEL-VL-F, Ft. Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

4.0033, ENGINEERING AND INSTRUMENTATION SUPPORT FOR ROCKET AND BALLOON LAUNCH OPERATION

R.A. BUMGARNER, New Mexico State University, School of Arts & Sciences, *Las Cruces, New Mexico* 88001 (DF247520; F19628-76-C-0171)

AF function - command, control and communications. Deficiency - reduced effectiveness for supporting research rocket firings at WSMR and research balloon launches at Holloman AFB. Objective - to provide effective engineering and instrumentation support during the launching of scientific rocket and balloon payloads at WSMR and Holloman AFB. How research contributes - the instrumentation systems developed allow the aerospace investigations to be conducted on a timely and cost-effective basis. Projects depending on this research include 1366, 6687, 6688, 6690, 7659, and 7670.

The technical approach includes integrating range safety, tracking and recovery systems into rocket payloads to be launched in support of various scientific programs. A telemetry facility will be maintained and operated to provide for the prelaunch testing of the instrumented research rockets to be launched at WSMR. Approach also provides for equipment calibration and data analysis during balloon launches at Holloman AFB, New Mexico. Coordination will be provided between the instrumentation engineers and the launch sites to satisfy documentation or other technical interface requirements.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Geophysics Laboratory LC, L.G. Hanscom AFB, Bedford, Mass. 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0034, STUDIES IN ROTATIONAL FLOWS, ESPECIALLY ASYMPTOTIC METHODS 12373-M

G.S. LUDFORD, Cornell University, School of Engineering, *Ithaca, New York* 14850 (DA0E8974; DAAG29 76 G0306)

Develop mathematical techniques for deducing physically realistic solutions in fluid mechanics with special stress on rotational flow problems. Development of rigorous mathematical tools for the study of dynamics of rotating fluids has considerable relevance to the Exterior Ballistics Laboratory at BRL and Army Aerodynamic Research. Specifically, this study may enhance our understanding of the performance of projectiles and missiles, in particular the influence of free boundary layers on the internal motion of payloads.

The method of matched asymptotic expansions with or without a turning point.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0035, MOLECULAR AND CHEMICAL LASER SYSTEMS 12200-PX

G.J. WOLGA, Cornell University, School of Electrical Engin., *Ithaca, New York* 14850 (DA0D9266; DAAG29 76 G0129)

To develop a 1.3 micron CW laser and to study electronic-to-vibrational energy transfer. This program will provide information conerning the feasibility of obtaining high-energy laser systems based on the chemical production of electronically excited laser species. The effort will be jointly funded by the Army Missile Command and is expected to contribute to the planning of the Army's chemical laser research and development.

A detailed study will be made for the chemical production of the electronically excited iodine atom I((1/2)P sub 1/2) in fractional concentration suitable for attaining population inversion and laser action at 1.315 microns. Quantitative E-to-V studies will be made using the iodine atom as the excited reaction partner. Studies will also be made of the achievement of CW infrared laser based upon E-to-V energy transfer mechanisms.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Rsch. Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0036, ORDERED ORGANIC SYSTEMS AND MOLECULAR RECTIFIERS 12674-C

B.A. SCOTT, Internat. Bus. Machines Corp., *Yorktown Heights, New York* 10598 (DA0E5572; DAAG29 75 C 0010)

To synthesize organic molecules with the capability of rectifying alternating currents. Relevance - this is an effort to determine whether there is any theoretical limitation to the smallness of an electronic component. The starting point is the design of a rectifier made of a monomolecular film. The DoD, as a large user of electronic components, has a need for miniaturization, which lowers costs, improves reliability and decreases weight and power requirements.

Will include deposition of monolayer films composed of ordered long-chain organic molecules incorporating the groups expected to confer the rectifying capability. Magnetic and other phase transitions will also be subject of study for increased understanding of the basis for conductivity and piezoelectricity.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Rsch. Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0037, TURBULENT BOUNDARY LAYER ON SPINNING BODIES OF REVOLUTION 12675-E

F. DEJARNETTE, Univ. of North Carolina, School of Engineering, *Raleigh, North Carolina* 27607 (DA0E8923; DAAG29 76 G0303)

The scope of this investigation is the determination of a simplified analytical method for calculating the three-dimensional, turbulent boundary layer on a spinning body of revolution at an angle of attack to a uniform oncoming stream. Non-symmetry produced in the boundary layer on this spinning body is to be determined in order to calculate its effects on the magnus force. For many years, Army scientists at both BRL and MICOM have been interested in developing an analysis method for predicting the magnus forces which occur on spinning missiles and projectiles. These magnus forces cause the projectile to become unstable along its flight path, creating large dispersions at the target area. Recently, this problem has been recognized to be caused by asymmetries in the turbulent boundary layer. The simplified method discussed in this proposal should allow Army engineers to quickly estimate the magnitude of this magnus force and to provide suitable countermeasures.

A spinning circular cone will be analyzed, firstly for incompressible flow, utilizing existing methods for the laminar portions of the boundary layer and developing a momentum integral method for the turbulent portion of the boundary layer. The nonsymmetric distribution of the displacement thickness will be calculated in order to determine the subsequently produced side force (magnus force). Velocity correlations required for the momentum integral method will be derived from the 'Law of the Wall' for the axial velocity component and from various holograph models for the transverse velocity component.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0038, INVESTIGATION OF D-REGION BACKSCATTERING PROCESSES 11054-GS

W.A. FLOOD, Univ. of North Carolina, School of Engineering, *Raleigh, North Carolina* 27607 (DA0D9299; DAAG29 76 G0138)

To conduct a comprehensive investigation of the accuracies of ground-based radio techniques for sounding the motions and electron densities in the ionospheric D-region between 6 km and 110 km. Upper air winds affect rocketry (BRL, MICOM, ASL) and ionospheric drifts affect communications (e.g., VLF communications program). This ground-based technique for wind measurement in the 60-110 km interval could replace the wind measurements of the cooperative meterological rocket network with obvious advantages.

Specific studies include: a) Assessment of the validity of the randomly phased angular spectrum approximation as it applies to HF radio wave ionospheric drift measurements. b) Determination of the amplitude and distribution of D-region echoes as a function

of altitude and pulse length. c) Investigation of the presence and cause of orthogonally polarized D-region echoes. d) Determination of the cone angle of arrival of D-region echoes and correlation of the cone angle measurements with the orthogonally polarized D-region echoes.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0039, SURFACE PASSIVATION AND METAL-SEMICONDUCTOR CONTACTS FOR COMPOUND SEMICONDUCTORS 14297-EL

H.R. WITTMANN, Univ. of North Carolina, Graduate School, *Raleigh, North Carolina* 27607 (DA0E9124; DAAG29 76 G0225)

To investigate 3-5 compound semiconductor interfaces. Relevance - this work is relevant to almost all present or planned active electronic devices which rely on 3-5 compound semiconductors such as field effect transistors, charge coupled devices, transit time devices, photocathodes, etc.

To study passivation of 3-5 compounds with native oxides and with TiO sub 2 and to study Shottky barriers with novel contacting metal combinations.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0040, INVESTIGATION OF TRAFFIC DYNAMICS BY AERIAL PHOTOGRAMMETRY TECHNIQUES

J. TREITERER, Ohio State University, Engineering Experiment Station, *Columbus, Ohio* 43210 (021281 (HRB NO.))

Aerial photogrammetric data collection techniques will be used to study practical problems of highway operation and design and to investigate certain theoretical aspects of traffic dynamics. Special efforts will be devoted to determine the characteristics of peak-hour traffic flow on urban freeways as these characteristics affect procedures of traffic control. Traffic flow models will be examined to determine the limits within which these models are valid. In addition, a continuing effort will be made to improve the aerial data collection and reduction technique. Reports issued: Investigation of traffic dynamics by aerial photogrammetry techniques, J. Treiterer, EES 278-3, June 1970. Investigation of traffic dynamics by aerial photogrammetry techniques, J. Treiterer, EES 278-4, November 1972. Loop detector sensing systems study, J. Treiterer, EES 278-5, August 1974.

ADDENDA: Document provided to S.S.I.E. by the H.R.I.S. This project is also supported by: Ohio Department of Transportation.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

4.0041, ACCELERATED LIFE-TEST VERIFICATION FOR AEROSPACE NICKEL-CADMIUM CELLS

D.F. PICKETT, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (DF455870)

To verify a proposed highly accelerated cycle-life test deriving from work under 31452250 and 31452251 and a critique of the final report (AFAPL-TR-74-75), to verify the cycle-life model proposed in the analysis 'Model building and prediction of NICAD cell cycle life' (JJ Lander, 25 May 73) to accomplish the above with 'Pickett process' plates, to determine cycle life of cells made with 'Pickett process' plates (31452240).

Continuously cycle 5-cell groups at nine combinations of DOD and temperature (say 30, 50, 70 percent DOD and 60, 80 and 100 degrees F) after establishing initial capabilities. During first 200-300 cycles remove cells periodically for capacity checks each at the 1, 2, 4, and 6 C rates. Establish change in R and in intercept of I-V curves as proposed in the critique. From the latter establish slope of degradation when it becomes constant which is derived from the second derivative of degradation rate becoming constant. Predict life for each combination of DOD and T based on degradation rate curves. Match against curves at modelling report and predict life cycle to failure to correlate and establish cycle life of cells made with the 'Pickett process' plates.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Aero-Propulsion Laboratory POE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0042, STUDY OF LASER EFFECTS ON HEAT SHIELD MATERIALS 14077-MSX

P. ZAVITSANOS, General Electric Company, *Philadelphia, Pennsylvania* 19101 (DA0E9127; DAAG29 76 C 0043)

To conduct experimental and analytical investigations in order to identify the pertinent kinetics and thermomechanical mechanisms associated with the degradation of heat shield materials under conditions of laser irradiation in vacuum and low-pressure air. As stated by the Army reviewer, the proposed research is highly relevant to the activities of the Army High-Energy Laser Systems Program Office and addresses Army 6.1 needs in the area as cited in the Army Laser-Hardened Materials and Structures Plan (1974).

This program will include, but not be restricted to, the following: for the generic classes of thermal protection materials, carbon phenolic, phenolic asbestos, and silica phenolic for laser heat fluxes ranging from about 1 watt/cm (2) to 10,000 watts/cm (2) and above; (1) the kinetics of the degradation processes will be investigated. (2) An analytical model of the heat transfer, energy dissipation, and resulting mass transfer will be used in an effort to describe observed laboratory effects. Reaction kinetics ablation program (KEKAP) code modifications will be made. (3) Post-test characterization of samples will be used to provide mechanistic information about crack generation, spallation, and performance capability degradation.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0043, EVALUATION OF A FLUIDIC OXYGEN SENSOR

R.L. WOODS, Univ. of Texas, School of Engineering, *Arlington, Texas* 76019 (DF319960; F41609-76-C-0028)

The contractor will verify the fluidic concentration sensing concept using the sensor constructed by USA Harry Diamond Laboratories for USAFSAM. The sensor's operational characteristics, environmental sensitivities, and operational support requirements will be quantitatively evaluated. Subsequently an assessment of the sensor's potential integration into a feedback-control oxygen delivery system will be performed. This effort is part of a line of endeavors to develop oxygen delivery control devices which will result in improved aircrew safety, yet optimize oxygen usage, maintenance, and reliability.

Using the existing sensor as a starting point, the contractor will fabricate or provide additional hardware elements for fluidic interfacing. Initial evaluation will concern experimental assessment of the sensor's inherent accuracy during exposure to simulated aerospace environments. In particular the interfering effects of carbon dioxide and water vapor in sample and reference gases will be detailed. Satisfactory findings for sensor accuracy, as assessed by a USAFSAM review panel, will be followed by design and implementation of fluidic amplifiers and ancillary components for purposes of boosting sensor output signals to control-compatible levels. A final technical report will explicitly enumerate the sensor concept's potential for utilization with on-board oxygen delivery schemes. ASD requirements for this effort are documented in ASD/SM letter of 31 Mar. 75. To assure appropriate integration of biomedical and engineering considerations, the progress, data, and reports on this effort are jointly monitored by AFFDL.

SUPPORTING AGENCY ADDRESS INFORMATION: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0044, CONTINUUM OBSERVATIONS OF RADIO SOURCES AT 2 MM WAVELENGTH
J.R. COGDELL, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: Recent advances in the sensitivity of radio receivers at high microwave frequencies have made possible observations of radio sources in the 2 mm atmospheric window at the Millimeter Wave Observatory. Such observations are being made cooperatively with the planetary program described in collaboration with Dr. Beverly Wills and Dr. Bruce Ulrich of the Astronomy Department.

Sources observed include quanstellar objects (QSO's), galactic H11 regions, supernova remants, the galactic center, radio and IR galaxia, and variables such as BL Kac, and certain QSO's. Observations are made in conjunction with other observatories for the variable object. The purpose is to extend the spectra of these objects and bridge the gap between the cm-microwave and the infrared measurements. Predictions of outbursts of certain variable objects is also a goal.

SUPPORTED BY University of Texas

4.0045, STUDY OF NUMERICAL METHODS FOR OPTIMIZATION OF STRUCTURES SUBJECT TO AEROELASTIC CONSTRAINTS
R.R. CRAIG, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: This study seeks to determine efficient methods for designing aerospace structures for minimum weight subject to static and dynamic (e.g., flutter) constraints. The gradient-projection method, previously applied to small-size problems of this type, will be compared with alternative methods and will be applied to more realistically sized design problems.

SUPPORTED BY University of Texas

4.0046, CRITICAL SURVEY AND EVALUATION OF ALL REMOTE SENSORS USING ELECTROMAGNETIC WAVES
A.H. LAGRONE, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: Electromagnetic waves are currently being used as remote sensors of weather, clear atmospheric phenomena, atmospheric pollution, migration of birds, vegetation, soil conditions and mineral surveys. Remote sensors are being used in space to study planetary surfaces, planetary atmospheres and in searching for extraterrestrial life forms.

This study is aimed at a theoretical description of the technique being used, an evaluation of the degree of success of the technique, alternatives available, and the results of the technique to date.

SUPPORTED BY University of Texas

4.0047, POTENTIAL FLOW ABOUT LIFTING CONFIGURATIONS IMPULSIVELY STARTED FROM REST
J.M. SUMMA, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: The Green's function solution (finite-element method) is used for the calculation of potential flow due to impulsive motion of isolated wings.

SUPPORTED BY University of Texas

4.0048, PROTOTYPE OZONESONDE FABRICATION
J. SMITH, Univ. of Texas, School of Engineering, *El Paso, Texas* 79999 (DA0D2259; DAAD07-75-C-0110)

Procurement of ten prototype ozone-temperature payloads.

The design of the rocket-borne ozone-temperature sonde shall be modified to incorporate the increase in the flow rate across the chemiluminescent disc by the use of impact flow. The electronics of the sonde shall also be modified to include integrated circuits and temperature-compensated timers for the pulse-position modulators.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Atmospheric Sciences Lab., AMSEL-BL-D, Wsmr., N.M. 88002

SUPPORTED BY U.S. Dept. of Defense - Army

4.0049, TUNED DIODE LASER MEASUREMENTS OF ATMOSPHERIC ABSORPTION PROFILES IN THE 4.5 MICROMETERS SPECTRAL REGION 13695-GSX
R.E. MEREDITH, Science Applications Inc., *Arlington, Virginia* 22209 (DA0E9137; DAAG29 76 C 0050)

To obtain extensive high-resolution absorption profile information for H20, CO2 and CO vibration-rotation bands in the 4.5 micrometer - 5.0 micrometer spectral region. Relevance - relevant to ongoing research in support of the DoD High-Energy Laser Propagation Program. Improved understanding of absorption of the CO emission region also has relevance for the operation of infrared imaging systems as well as CO lasers.

Perform tuned diode laser spectroscopic measurements and analysis to determine spectral line parameters and shapes in the 4.5 micrometer - 5 micrometer spectral region. Determine strength and width parameters and deviations from Lorentz shape for individual vibration-rotation lines of H20, CO2, and CO broadened by N2 and O2. Investigate H2O, CO2 and CO lines with emphasis on H2O absorption in the 4.5 - 5.0 M region. Determine quantitative deviations of strength and width values and line shape parameters from theoretical prediction.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

4.0050, THE NUMERICAL STUDY OF TRANSITION AND TURBULENT FLOWS
S.A. ORSZAG, Flow Research Incorporated, *Kent, Washington* 98031 (DN223449; N00014-72-C-0355)

An understanding of turbulent flow and transition from laminar to turbulent flow is central to the development of a design methodology for predicting viscous phenomena associated with aircraft, missiles and ships. The present research is a numerical study of turbulence and transition, within the framework of the Navier-Stokes equations, to assess the accuracy of commonly used turbulence closure models, and to develop a better understanding of laminar instability and transition to turbulent flow.

An accurate prediction of turbulent flow and the transition of laminar flows to turbulent flows, without arbitrary transport assumption (closure conditions), would represent a major advance in our understanding of such phenomena and our ability to incorporate such information in naval systems design. In the present research, the Navier-Stokes equations will be solved numerically by a spectral method without closure assumptions for a class of basic problems. To assess the validity of closure models, these calculated results will then be used to verify the validity of the assumed relationships between the mean flow properties and the time-averaged properties in the closure models. The study of transition will compare the numerical predictions in the closure models and for plate flows. The numerics will then be extended to pipe flow transition problems which have defied theoretical understanding.

SUPPORTING AGENCY ADDRESS INFORMATION: Office of Naval Research, Arlington, Va. 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0051, VERIFICATION ENVIRONMENTAL CONTROL SYSTEM DYNAMICS COMPUTER PROGRAM
G.W. BROOKS, Boeing Company, *Seattle, Washington* 98108 (DF138030; F33615-76-C-3100)

The instability of environmental control systems (ECS) causes adverse effects on the performance, reliability, and cost of other aircraft subsystems, and premature failure of ECS components. The objective of this effort is to validate the output of a new developmental transient analysis program through experimental test and training. The computer program is designed to predict system dynamics and thus leads to stable ECS control systems.

An existing ECS system will be fully instrumented and operated under various mission conditions so that its performance can be compared with that predicted by a developmental analytical program. Deficient models or characteristics will be corrected. Government engineers will be trained in use of the developmental program so that problems can be corrected prior

to formal release. The product will be a fully verified transient analysis program.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Flight Dynamics Laboratory FEE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, LOWER-UPPER ATMOSPHERE COUPLING DURING PERIODS OF SEVERE WEATHER 13409-GS

R.J. HUNG, Univ. of Alabama, School of Science & Engin., *Huntsville, Alabama* 35807 (DA0E9007)

To investigate the dynamics of coupling between the lower and upper atmosphere during periods of severe weather activities. The work will lead to improved methods of detecting the possibility of severe storms from use of photographs from satellites. The military interest ranges from protection of troops and equipment to taking advantage of enemy losses from severe storms. The work supplements the Army Atmospheric Sciences Laboratory Satellite Storm Detection (SATSTM) program.

The experimental phase of the work involves improving Doppler remote-sensing techniques through analysis of continuous-wave Doppler signals transmitted from three sites in Alabama and received after reflection from the ionosphere at NASA/Marshall Space Flight Center, Huntsville, Alabama. The theoretical phase of the work involves calculation of infrasonic wave properties such as mechanism of excitation, damping rate of dispersion and relationship to electron density and wind profiles.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

5.0002, EARLY DETECTION AND CORRECTION OF SINKHOLE PROBLEMS

J.G. NEWTON, U.S. Dept. of the Interior, Geological Survey, *University, Alabama* 35486 (105644 (HRB NO.))

The purposes are to: inventory areas which have active sinkholes or which are susceptible to sinkhole development; evaluate remote sensing for the location of potential sinkholes; and establish guidelines to define potential sinkhole problems along existing roads or in proposed highway corridors. /FHWA/

Document provided to S.S.I.E. by the H.R.I.S.

ADDENDA: This project is also supported by: Alabama State Highway Department.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

5.0003, HURRICANE MODEL - BRIGHTNESS TEMPERATURE

D. ROSS, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8B326246)

OBJECTIVE: The objective of this project is to conduct research on ocean waves in a manner complementary to the needs of the remote sensing interests of NOAA.

CURRENT YEAR PLAN: The current year plan is to initiate development of a parametrical model to predict microwave brightness temperature distribution in hurricanes. Two hurricane wind and wave models have been developed and made operational on the AOML 1108. These models will be modified to predict the brightness temperature distributions.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0004, DEVELOPMENT OF LASER TECHNIQUES FOR ATMOSPHERIC SENSING 11876-GS

C.Y. SHE, Colorado State University, School of Natural Sciences, *Fort Collins, Colorado* 80521 (DA0D9284; DAAG29 76 G0148)

To develop new techniques for determining atmospheric motions. This capability is the highest priority in the Atmospheric Sciences Laboratory program for developing an automated meteorological system; it would make possible substantial improvement in artillery accuracy. In a longer range view, the research may also lead to remote sensing of turbulence, temperature, humidity, and particulate concentration and size, and be important to a number of military concerns, including microwave communications, laser systems used in the ambient atmosphere and prediction of mesoscale weather. Three Army laboratories have programs which will benefit from this work.

An experimental and theoretical program will be conducted to investigate and develop the technique of laser cross-beam-photon- correlation spectroscopy for the remote measurement of both laminar and turbulent flows under different temperature and moisture conditions. After successful completion of the laboratory work, field testing from the laboratory will be conducted and, if warranted, an airborne system will be constructed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Rsch. Office, P.O. Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

5.0005, INTERPRETATION OF LANDSLIDE-SUSCEPTIBLE AREAS BY AERIAL PHOTOGRAPHY

M. AKUTAGAWA, Express Hwy. Res. Fdn. of Res., *Tokyo, Japan* (085283 (HRB NO.))

The aim of this study is to develop a method of interpreting the aerial photography to distinguish landslide-susceptible areas by reviewing and analyzing the existing studies about landslides. The guidelines will be established in a few years. /IRF/

ADDENDA: Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY Japanese Public Highway Corp. - Tokyo

5.0006, DEVELOPMENT OF WATER POLLUTION CONTROL SYSTEMS FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY AIRPORTS

R.J. PILIE, Calspan Corporation, *Buffalo, New York* 14221

DESCRIPTION: In a continuing effort to maintain and protect the ecology of the natural waters adjacent to Kennedy, LaGuardia and Newark Airports, the Port Authority of New York and New Jersey has retained Calspan Corporation to undertake a comprehensive analysis of the effect of the airport's storm and runoff waters on these surrounding water bodies. Extensive precautions and special disposal facilities have been utilized thus far at each airport to avoid the pollution of surrounding waters. The existing drainage system serving maintenance, fuel and service facilities at the airports include oil separators and catch basins. Waste disposal facilities are provided in areas where airport operations require the handling of chemical and petroleum products. Moreover, the Port Authority and the airlines and other tenants have undertaken rigorous monitoring and control programs to assure that the disposal of such wastes is done in an environmentally sound manner. Nonetheless, there is concern that potentially detrimental wastes possibly could work their way into the airport drainage systems and be discharged with rainwater into the adjacent bays. The Port Authority has retained the company to evaluate this potential problem and to develop preventative measures. In a comprehensive two-year program, the company will: (1) collect data, including an inventory of all chemicals and other substances in use on the airports; (2) analyze samples collected and their relationship to environmental quality; (3) determine immediate preventive and corrective measures and (4) determine long-term control systems including control alternatives, new treatment processes and construction of facilities that may be required.

SUPPORTED BY New York City Government - New York

5.0007, WAVE PROPAGATION AND THE BEHAVIOR OF THE ATMOSPHERE AND IONOSPHERE 12286-GS

W.L. DONN, Columbia University, School of Arts & Sciences, *New York, New York* 10027 (DA0E8905; DAAG29 74 G0172)

To study long-range propagation of acoustic waves in the atmosphere including the ionosphere. The information obtained will help in the prediction of the effects of ionospheric tilting and multipath conditions of HF radiowave propagation and will be applied to reduce bearing errors in a single-site radio emitter locator system currently under Army development. The research is also relevenat to an Army program to study acoustic waves from satellities and from the ground to determine their contribution to the occurrence of severe storms and their role in interactions between the lower and upper atmosphere relevant to ABMDA concerns.

The work involves the observation of long waves with a number of sensing systems capable of detecting gravity and acoustic waves in the atmosphere. Trace velocities, directions and spectral content of the signals are determined through the use of on-line and off-line computers. Theoretical studies involve utilizing the observations in determining atmospheric conditions which contribute to the nature of the wave propagation. A continuous-wave ionospheric height detection system will be developed and used to obtain wave group path information in the ionosphere through continuous monitoring of the height of reflection of high-frequency radio waves.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

5.0008, THE DETERMINATION OF ATMOSPHERIC STRUCTURE FROM QUANTITATIVE SATELLITE DATA 13520-GSX

J.R. SCOGGINS, Texas A & M University System, School of Geosciences, *College Station, Texas* 77843 (DA0E9002; DAAG29 76 G0078)

To determine the properties of the atmosphere from quantitative temperature and humidity, and cloud cover data provided by the Nimbus 6 satellite, and through comparisons with conventional data to determine the limitations of such data for sensing the atmosphere. Satellite meteorology in general, and this proposal specifically, has high military interest because of the possibility of observing the weather in 'silent areas' where conventional observations are not available. The data would be used in various applications including prediction of nuclear fall-out, determination of conditions for Army aviation, and assessment of trafficability.

Specific analytical approaches will be devised for comparison of vertical and horizontal gradients of meteorological parameters observed by conventional radiosonde (balloon) observation (RAOBS) and by Nimbus 6 sensors. Comparison will be made for selected high, middle and low latitudes, and for differing weather events.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

5.0009, INVESTIGATION OF ELECTRON PRECIPITATION ASSOCIATED WITH VLF ACTIVITY AT SIPLE STATION, ANTARCTICA

W.R. SHELDON, Univ. of Houston, School of Arts & Sciences, *Houston, Texas* 77004 (DPP76-22135)

It is proposed to complement the already intensive campaign to investigate magnetospheric wave-particle interactions at Siple Station in the austral summer 1977-78 through addition of an X-ray flux experiment. The measurements will be made with a parachute deployed X- ray detector which has been launched to approximately 85 km (above 1 gm/cc atmospheric thickness) aboard a Super Arcus rocket. About 15 minutes of data will be obtained from altitudes above 30 km. The X-ray measurements will provide flux and spectra information about trapped particles (electrons) precipitated as a result of wave-particle interaction.

Rockets will be launched at times when VLF activity indicates that an interesting event, natural or artificially stimulated, is in progress. Similar measurements have been made from 30 km altitude but artificially precipitated electrons have not been detected. It is expected that the Siple VLF transmissions may precipitate electrons at lower energy than can be observed at 30 km; they simply do not penetrate to that depth. The technique proposed will place the detectors at an altitude where the lower energy electrons (approximately 5kev) can be detected. Another advantage of this technique is that it is wide angle and inspects a large region. The results will be compared with measurements made at approximately 210 km to deduce the size of the precipitation ducts along which emissions propagate. The results will provide a more accurate estimate of the constant used to relate an observed X-ray spectrum to the parent electron spectrum.

Results will be correlated with that from Nike Tomahawks (150- 250km), balloons (30km), ground-based detectors and with previous results from the same geomagnetic latitude but different geographic latitude. The last comparison will be made to see if position with respect to the solar wind leads to different results.

SUPPORTED BY U.S. Natl. Science Foundation

5.0010, OGO VI HIGH-RESOLUTION ION TRAP STUDIES OF IONOSPHERIC IRREGULARITIES

J.P. MCCLURE, Univ. of Texas, Center For Space Sciences, *Richardson, Texas* 75082 (ATM76-17351)

This grant funds a study of ionospheric irregularities using two recently acquired sets of unique data. These data are from the Jicamarca Radio Observatory's new multi-beam antenna and from the new high-resolution ion trap experiments on three Atmosphere Explorer satellites. These data will be used for detailed studies of the physical structure and motions of irregularities in the ionosphere.

SUPPORTED BY U.S. Natl. Science Foundation

5.0011, THE DEVELOPMENT OF IMPROVED METHODS OF SITE INVESTIGATION IN MOUNTAINOUS TERRAIN SUBJECT TO LANDSLIDING

J.W. DOWLING, Ministry of Transport, Transport & Road Research Lab., *Crowthorne, England, United Kingdom* (085790 (HRB NO.))

Substantial cost-overruns in road works overseas, particularly in mountainous terrain within the topical zone, suggest that site investigation practice in these conditions is inadequate and that the geological factors that contribute to instability largely go undetected. Studies are being made of a variety of appropriate survey techniques that should substantially improve ways of predicting the presence of ground hazards, including landsliding. These include geophysical surveying methods, the interpretation of aerial photography and terrain evaluation (land classification) techniques. Terrestrial photogrammetry has also been developed to produce contoured maps more effectively than by conventional surveying methods. Attention will also be paid to other forms of remote sensing, particularly multi-spectral photography from light planes. Field work has been carried out in Colombia and more is planned. Other studies will be made in Nepal. /IRRD/IRF/

ADDENDA: Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY United Kingdom - Min. of Overseas Devel.

5.0012, ALASKAN INCOHERENT-SCATTER RADAR INVESTIGATIONS OF THE HIGH-LATITUDE IONOSPHERE

J.R. DOUPNIK, Utah State University, School of Engineering, *Logan, Utah* 84321 (ATM76-17334)

This grant continues experimental investigations of magnetospheric convection in the auroral zone and its effects on the ionosphere using data obtained from the Chatanika, Alaska, incoherent-scatter radar system. The primary objectives are studies of the properties of the convection electric field in the auroral oval together with the related geophysical quantities such as electron density profiles, electrical conductivities and currents, neutral winds in the E region, and atmospheric heating rates due to ion-neutral friction and to precipitating energetic particles. A series of radar measurements will be made to investigate a number of specific aspects of the electric field; its spatial structure over very large areas in the polar cusp region, at the boundary between the auroral oval and the polar cap and in the main

electron trough region. Similarly, other experiments will be made to investigate the formation of the trough in relation to the several theoretical mechanisms. Several cooperative experiments are proposed with instruments aboard the Triad, ISIS, and AE-D satellites and with a prospective series of balloon-launched packages in Alaska, in these experiments this grant would support acquisition of the Chatanika radar data.

The above experiments are ideally suited to the aims of the International Magnetospheric Study.

SUPPORTED BY U.S. Natl. Science Foundation

5.0013, LIDAR MEASUREMENT OF BOUNDARY LAYER WINDS AND CONVECTIVE STRUCTURE 13535-GS
J.A. WEINMAN, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (DA0E9033; DAAG29 76 G0156)

To study convective structure and remotely determine winds in the planetary boundary layer under a variety of meteorological conditions, and compare lidar-derived winds with conventionally derived winds. Real- time wind measurements and investigation of convective structure of the lower atmosphere are needed to support: (1) the wind correction for atmospheric general-purpose rockets under development and older systems in operation; (2) the transport and diffusion research at Dugway Proving Ground; (3) aircraft landings and takeoff; and (4) the forecast of local weather conditions.

Simultaneous atmospheric measurements using high spatial and temporal resolution monostatic lidar, a miniature radiosonde, and acoustic sounder, and an 86-meter tower instrumented to measure sensible heat and momentum fluxes. Obtain lidar wind under a variety of meteorological conditions and study convective structure revealed by aerosol-density inhomogeneities.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, RESEARCH PSYCHOLOGY APPLIED TO MEDICALLY SIGNIFICANT PROBLEMS IN ARMY AVIATION (06)
M.A. HOFMANN, U.S. Army, Aviation Psychology Division, *Ozark, Alabama* 36360 (DA0D6738)

To provide US Army aviation information that is medically important about the human factor in the aircraft man-machine system, with special emphasis on the performance of this human factor and the variables that influence it.

The approach will involve the application of current research techniques applicable to the objective as well as developing new techniques as required.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MD R & D Com., (Army) Aeromedical Res. Lab., Ft. Rucker, Al. 36360

SUPPORTED BY U.S. Dept. of Defense - Army

6.0002, DIRECT FIELD RESEARCH SUPPORT TO IMMEDIATE ARMY AEROMEDICAL PROBLEMS (02)
S.C. KNAPP, U.S. Army, Aeromedical Research Lab., *Ozark, Alabama* 36360 (DA0D6734)

Provide US Army aviation with sound and timely bioengineering information to solve operational problems generated in the interface of the physical and life sciences.

The techniques employed will vary, depending on the problem area, but will be based on sound accepted experimental methodology designed to provide the required information as expeditiously as possible.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MD R & D Com., (Army) Aeromedical Res. Lab., Ft. Rucker, Al. 36360

SUPPORTED BY U.S. Dept. of Defense - Army

6.0003, CARDIOVASCULAR AGING IN YOUNG MEN AND WOMEN
W.K. HARRISON, Univ. of California, School of Medicine, *San Diego, California* 92038 (HL 20373-01)

Newly developed computer analyzed noninvasive techniques will be used in this study of physiological aging. Many different quantitative aspects of cardiac function measured by these techniques will be evaluated in a selected group of men and women 20 - 40 years of age. Sex differences in aging members of the group will be examined after effects due to body size and other sources of unwanted variablity have been controlled. Effectiveness of the multiple-objective physiological measurements of cardiac function as estimates of chronological age will be tested in data obtained. Healthy airline pilots, stewards, and stewardesses will undergo detailed medical evaluation before the special tests are given at the airline medical department (UA laboratory). High-fidelity ballistocardiograms (Bcg) and percutaneous carotid arterial pulse recordings (CP) will be obtained according to a new computer-oriented procedure developed by the applicant. The specially formated analog tape recordings of these tests will subsequently be converted into digital tape format by an edit program in an institutional computer. These edited digital tapes will be analyzed by another program for feature recognition and detailed measurement of Bcg and CP in the same computer. Results of these analyses, along with clinical data on the subjects, will then be evaluated with the aid of standard biomedical statistical programs to elucidate aging trends which are expected in the data.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - N.I.H.

6.0004, PHYSIOLOGIC OXYGEN DELIVERY DURING INTERACTIVE ENVIRONMENTAL STRESSES
M.P. HLASTALA, Univ. of Washington, School of Medicine, *Seattle, Washington* 98122 (DF319780; F41609-76-C-0016)

Proposed airborne breathing systems such as on-board open/closed- loop oxygen-generating systems require development of new specifications for breathing gas composition. The purpose of this effort is to develop a tool, composed of a series of interactive mathematical formulations based on physiologic entities, which will provide rationale and criteria required to establish design specifications for advanced oxygen systems. Specifications, to replace the current MIL-D-l9326 and MIL-D-8683 must apply to specific aircraft types to accommodate the particular interactive stresses imposed. Revision of MIL-R-83187, to conserve oxygen for on-board generating systems, must provide for protection from decompression and performance decrements associated with low-grade hypoxia, while at the same time preventing atelectasis and other physiologic derangements caused by high oxygen concentrations. The eventuality of deploying open/closed-loop oxygen-generating systems on high-performance aircraft such as the F-16 and F-15 requires assessment of the effects of multiple interactions including acceleration, altitude, and breathing gas composition. Currently there is no specification for carbon dioxide accumulation levels in pressure suit helmets or helmets to be used for protection from toxic atmospheres. Interactive effects of carbon monoxide must also be considered for smokers and those using oxygen generators producing low levels of carbon monoxide. The importance of this effort and characteristic which differentiates it from previous work is its comprehensive treatment of multiple physiologic stresses specific to aircrew environments. This formulation will also enable realistic physiologic assessment of specific conditions imposed by equipment tested and evaluated in-house at USAFSAM. Further, it will define critical levels of breathing gas partial pressure for correlation with data on performance decrements.

Development of biomedical criteria and specifications for safe physiologic limits for the constituents of breathing gases requires an integrated systems analysis of the physiologic system both with respect to the multiple variables of inspired concentrations, acceleration and altitude and with respect to the realtionships between lung, the circulation and the body tissue beds. (Text Abridged)

SUPPORTED BY U.S. Dept. of Defense - Air Force

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, ALGORITHMS FOR EFFICIENT MATRIX COMPUTATION

J. DEPILLIS, Univ. of California, Graduate School, *Riverside, California* 92502 (DF041360; AF-AFOSR-2858-75)

The study of weapons effect on aerospace vehicles is of interest to the Air Force. Such study, as well as other areas of investigation, require the solution of systems of partial differential equations which in turn involve matrix computations. To obtain accurate and useful results it is necessary, in most cases, to increase the number of points in the discretization grid which brings a consequent increase in the level of matrix computation. In the last few years, advances in hardware development have shortened the time needed for such operations in the computer. Nevertheless, computational limitations still greatly restrict the complete study of weapons effects in a truly three-dimensional environment. Also, computational errors (i.e., roundoff) which are related to the number of computation remain at the same level when the speed of hardware computation is increased. Various aspects of research are important in the area of matrix computation. One involves the development of efficient techniques to handle very large matrices in the computer. Another is the reduction in the number of operations required to perform matrix operations in the computer. This research project addresses the latter. The objective of this effort is to develop fast algorithms and techniques for: (1) reducing the number of scalar multiplications required to multiply rectangular matrices together, (2) increasing the convergence rate for certain sequences. Subsequently, a number of computer experiments will be performed to test the algorithms developed.

SUPPORTING AGENCY ADDRESS INFORMATION: AF Office of Scientific Research NM, 1400 Wilson Blvd., Arlington, Va. 22209

SUPPORTED BY U.S. Dept. of Defense - Air Force

7.0002, CONTINUUM THEORY OF FRACTURE

M.E. GURTIN, Carnegie Mellon University, School of Arts, *Pittsburgh, Pennsylvania* 15213 (DF043720; AF-AFOSR-3013-76)

AF function - damage tolerance of advanced aerospace vehicles is essential to reductions in Air Force cost of ownership. Deficiency - due to increases in maintenance and spares cost and fleet-effectiveness decreases due to vehicle down time, new failure criteria are needed to accurately predict the fracture process under a wide range of material and environmental states. Objective - the objective of this research is to investigate new fracture theories within the framework of continuum mechanics which are based upon basic energy balance considerations. How work contributes - research contributes to improved failure-resistant designs for aircraft and solid propulsion vehicles.

Principal investigator is approaching the fracture problem as a rational treatment of energy balance. The energy of the fracture surface should be treated as a loss in binding energy caused by the creation of new fracture surfaces. Consideration will be given to the propagation of the fracture surfaces and the effects of temperature.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Office of Scientific Research NA, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, RELIABILITY PHYSICS STUDIES ON DOPED AL

J. BLACK, Motorola Incorporated, *Phoenix, Arizona* 85008 (DF735920; F30602-76-C-0300)

To provide funds for the study of doped aluminum conductor films in terms of their chemical and structural influence on integrated circuit reliability.

Appropriate test structures and IC's will be built with aluminum thin-film conductors doped with silicon or copper. Accelerated stress tests will be used to determine the chemical stability of these films, their resistance to electromigration, their interaction with other device features such as deposited dielectric layers and silicon contacts. The information generated on this study will be used to enhance IC reliability through improved test methods and general device specifications. The end item will be a report.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center RBR, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0002, MODULATION SPECTROSCOPY OF DISORDERED SOLIDS 11086-P

B.O. SERAPHIN, Univ. of Arizona, Graduate School, *Tucson, Arizona* 85721 (DA0D9077; DAHC04-74-G-0100)

Using modulation spectroscopy, an investigation will be made of the electronic structure of disordered solids for regions that are sensitive to perturbation by the standard modulation parameters. The electronics command indicates that this research will provide necessary information on electrical and optical properties of disordered semiconductors for future electronic components in advanced communication systems. Results of this research will also be relevant to semiconductor work and have implications for work on amorphous explosive solids within the weapons command.

The perturbation will be monitored by observing modulation of reflectance and transmittance for photon energies that correlate to these sensitive regions. The effect of the perturbation will be characterized according to its response to changes in temperature stress and electric field. It is further proposed to study the modulation response with respect to the type of disorder, positional and compositional, or a mixture of both.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0003, LINEAR AND NONLINEAR OPTICAL EFFECTS IN LIQUID CRYSTALS

Y.R. SHEN, Univ. of California, School of Engineering, *Berkeley, California* 94720 (DMR76-19843)

Research on linear and nonlinear optical effects in liquid crystals previously supported by NSF grant DMR74-07361 will be continued. A new set of linear and nonlinear experiments will be initiated. Emphasis will be on the study of self focusing, measurements of the third-order nonlinear susceptibility and the use of liquid crystals as laser pulse shapers. The results of these studies should yield better understanding of the properties of liquid crystals, help in unraveling the mystery of some nonlinear optical effects and lead to potential device application.

SUPPORTED BY U.S. Natl. Science Foundation

8.0004, EFFECTS OF NUCLEAR IRRADIATION ON THE ELECTRONIC PROPERTIES OF SEMICONDUCTOR MATERIALS AND DEVICES

J. SROUR, Northrop Corporation, *Hawthorne, California* 90250 (DA0A5689; DAAG39-75-C-0161)

To study the mechanisms of radiation-produced displacements and ionization effects in materials by measurement of the rate of change of minority carrier lifetime, carrier mobility, and carrier concentration.

Single crystals of Si containing various dopants are irradiated with neutrons, electrons and gamma rays. Changes in resistivity and minority carrier lifetimes are correlated with type of impurity and concentration. Lifetime measurements are made using X-ray,

electron beam and optical excitation methods. Transport properties of SiO sub 2 are determined using electron-beam excitation.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Harry Diamond Laboratories, AMXDO-RCB, 2800 Powder Mill Road, Adelphi, Md. 20783

SUPPORTED BY U.S. Dept. of Defense - Army

8.0005, PROCESSING OF OPTICAL IMAGES WITH OPTICALLY CONTROLLED ACOUSTIC TRANSDUCERS
B.A. AULD, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (DF044330; AF-AFOSR-3059-76)

AF function - an increasing number of military systems are employing visual communication processes, especially in the execution of command and control, target acquisition, identification, and surveillance. Opportunity - a major obstacle to visual communication or image transmission is the large bandwidth required to transmit the high information content of images. A substantial reduction in bandwidth can be achieved by sending the two-dimensional Fourier transform of the image rather than the image itself; however, current transformation techniques do not offer real-time operation. Objective - the proposed effort will develop a small-size, lightweight, two-dimensional analogue Fourier transform device capable of operating at least as fast as the standard TV scan rate. How work contributes - this research advances image processing for command and control systems.

The device will convert incoherent optical images into coherent acoustic images, and will Fourier transform the image through the use of a Fourier transform acoustic lens. The read-out of the transform pattern may then be accomplished through the use of an intensity-modulated laser beam which raster scans an output acoustic transducer incorporated into the device.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Office of Scientific Research NE, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0006, NONLINEAR PLASMA WAVE RESEARCH
J.H. MALMBERG, Univ. of California, Graduate School, *San Diego, California* 92037 (PHY73-05125 A03)

Research will continue on the fundamental physics of plasma, including both theory and experiment, and will emphasize problems for which very precise experimental tests of theory can be obtained. The experiments will use conventional neutralized plasmas, a nonneutral electron plasma, and for some of the beam experiments, an apparatus in which the background plasma is replaced by a slow-wave structure. A major emphasis of the research will be on nonlinear effects involving electron plasma waves. The behavior of test waves in plasmas which are already strongly nonlinear due to the presence of another large-amplitude wave at a different frequency will be studied. The effect of nonlinear beam dynamics on the evolution of the metastable state which initially limits the growth of waves in the beam-plasma interaction will be investigated. A second area of emphasis involves determination of 'classical' and 'anomalous' transport coefficients in nonneutral electron plasma. Extensions of the recently developed theory for the probability distribution of the Fourier components of the electric field in weak turbulence will be considered. Also, the stability of soliton solutions of the Korteweg-de Vries equation will be investigated.

This work is a continuation of that currently supported by Foundation grant MPS76-00997 A02.

SUPPORTED BY U.S. Natl. Science Foundation

8.0007, MANY-BODY SOLID STATE
D.J. SCALAPINO, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (DMR76-17373)

Research begun under NSF grant DMR73-07660 will be continued and extended, including studies of the physical properties of pseudo one- dimensional materials and phase transitions and related problems in quantum field theory. Specifically, techniques developed in the previous grant period will be applied to calculations of correlation functions for one-dimensional systems. Microscopic calculation of the parameters that enter the model Hamiltonians will be undertaken. Work on the mapping of a two-dimensional classical field problem into a one- dimensional quantum field theory problem will be pursued. Non- perturbative solutions to these quantum field theories will be investigated.

SUPPORTED BY U.S. Natl. Science Foundation

8.0008, EPITAXIAL GROWTH OF GE-GAAS
A.A. IMMORLICA, Rockwell International Corp., *Thousand Oaks, California* 91360 (DF044620; F44620-76-C-0134)

AF function - microwave solid-state electronic devices are essential components of Air Force surveillance, electronic countermeasures, and communications systems. Opportunity - GaAs Impatt diodes are limited in their efficiency due to the fact that the same material is used in both the avalanche and drift regions of the device. An improvement in efficiency is possible by using a narrow-bandgap material for the avalanche zone and a high-drift velocity material in the drift region. Objective - the objective of this research is to solve the materials growth problems of Ge-GaAs heterojunctions by employing state-of-the-art liquid-phase epitaxy techniques. How work contributes - a properly grown heterojunction of this type with Ge (narrow-bandgap) and GaAs (high-velocity) promises to produce Impatt devices with efficiencies up to 25 percent greater than those of GaAs read-type Impatts.

The main problem with liquid-phase epitaxy growth of a Ge-GaAs heterojunction is autodoping due to substrate dissolution. It has been found that the most critical factors influencing crystal formation v.s. autodoping by meltback of the substrate are the melt saturation conditions at the liquid-crystal interface and the thermal stability at this interface. The work proposed here will use a unique liquid-phase epitaxial system to grow Ge layers on GaAs substrates. This growth system is transparent so that one can observe the condition of the melt and experimentally determine the liquid-phase boundary as well as the degree of supersaturation of the melt. This system also includes a Ge source crystal in one pocket of the graphite platform. The Ge melt can then be precisely saturated by equilibrating the melt over the source crystal before commencing growth. A final feature of the system is the incorporation of a cold finger in intimate contact with the growth crucible. This cold finger can extract heat from the system and thus introduce a strong temperature gradient across the growth interface. This gradient increases the thermal stability at the interface and thus reduces the possibility of autodoping. The layers will be grown on both semi-insulating and conducting GaAs substrates. Layers will be characterized by optical scanning electron microscopy, X-ray topography, and other methods. (Text Abridged)

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0009, PHOTODETACHMENT STUDIES OF MOLECULAR NEGATIVE IONS 11892-P
E.C. BEATY, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (DA0D9183; DAHC04-75-G-0024)

Study the photodissociation and photodetachment of negative ions of No sub 2, No sub 3, Co sub 3, Co sub 4 and their hydrates. Photodetachment cross sections for negative atmospheric ions are needed to compute free electron density which affect: ionospheric communication systems (VLF, LF, MF, and HF); ionospheric detection systems (Early Bird Warning System); and nuclear detonation residual effects on the atmosphere.

I. Ions produced in a relatively high-pressure discharge will be allowed to reach thermal equilibrium in a vibrational sense, illuminated with a dye laser beam, and then be admitted to a quadrupole mass spectrometer for analysis. II. A relatively low-pressure ion source will inject ions into a high-vacuum chamber in which they are illuminated with a laser beam. Both neutral and charged fragments resulting from photodetachment or photodissociation will be detected.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0010, ELEMENTARY PARTICLES AND HIGH-ENERGY PHENOMENA

U. NAUENBERG, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (E(11-1)-2114)

For the next year, our proposed activities will include the following experiments: 1) To begin the measurement of neutral particle fluxes present in a pion-induced neutral kaon beam. This is a pilot experiment at Fermilab in the M2 beam line. Data will be used to facilitate the design of a neutronless neutral kaon beam. 2) To measure the flux of cosmic-ray magnetic monopoles whose energy is low enough that they may be stopped in the atmosphere. By using the extensive gathering power of the fifteen-foot bubble chamber at Fermilab, the limit for such monopoles may be lowered by a factor of twenty. 3) Our theoretical investigations will support the detailed analysis of long- lived neutral kaon interactions in hydrogen and deuterium. In addition, we shall continue to study gauge theories, with particular emphasis on strong coupling theories and on the delta I equals 1/2 enhancement in quark models.

RESULTS: In the decay of the neutral kaon we have found: 1) that the CP-violating parameter, epsilon, is about 10% higher than previously determined; 2) that CPT is conserved to within 2%; 3) that a quadratic term is needed in the matrix element for long-lived neutral kaon (pion 3) decay; 4) that the delta I equals 1/2 rule is violated in this decay. We have also found no evidence for the production of tachyon monopoles near a nuclear source or in cosmic rays.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0011, STRUCTURAL PHASE TRANSITIONS IN MOLECULAR CRYSTALS AND FERROELECTRICS

N.S. GILLIS, Colorado State University, School of Science, *Fort Collins, Colorado* 80521 (DMR-18738)

Work carried out under NSF grant DMR72-03202 in the area of structural phase transitions in simple molecular crystals and ferroelectrics will be continued. Two different problems will be studied; (a) molecular monolayer films, typified by molecular nitrogen adsorbed on graphite, (b) more complex ionic molecular crystals such as the inorganic azides, the alkali cyanides and the BaM 2ion F4 isomorphs. The common approach to all these research problems would be the application of primarily lattice dynamical techniques, in some cases supported by molecular dynamics and Monte Carlo studies, to study the coupled librational and phonon modes and their effect on the observed structural phase transitions.

SUPPORTED BY U.S. Natl. Science Foundation

8.0012, THERMAL AND ULTRASONIC TRANSPORT PROPERTIES OF DIELECTRIC AND PIEZOELECTRIC SOLIDS 11717-P

P.G. KLEMENS, Univ. of Connecticut, School of Liberal Arts & Sci., *Storrs, Connecticut* 06268 (DA0D9227; DAHC04-74-G-0068)

To study experimentally the effect of lattice defects on the thermal conductivity and attenuation of both bulk and surface ultrasonic waves of a number of dielectric crystals. Improvement of an understanding of phonon interactions is highly relevant to the operation of solid-state devices. The establishment of some additional properties of radiation-induced defects in dielectrics remains a definite possibility promising applications in the nuclear hardening domain. The program is also responsive to current trends in surface wave technology since crystals of interest will be studied. Study of the attentuation of surface waves should provide knowledge of the structure of surfaces which could be useful as direct guidance for ECOM programs in surface wave materials and devices.

The role of anharmonic phonon interactions and of phonon-defect interactions will be elucidated by comparing the effects of defects on the thermal conductivity and the ultrasonic attenuation. Methods will be improved to measure the attenuation of surface waves, and these measurements will be used to study the defect structure of surfaces, with emphasis on radiation damage. Theoretical studies will be carried out to support these experiments, and to investigate radiative heat transfer in composite structures and the propagation of elastic surface wave signals over irregular surfaces.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0013, STUDY OF A PROCEDURE FOR MAKING POLYCRYSTALLINE LAYERS OF SILICON ON CONDUCTING SUBSTRATES (SOLAR PHOTOVOLTAIC CELLS)

BELOUET, Electronic & Phys. Appl. Lab., *Limeil Brevannes, France* (6-75-7-0876-00)

Definition and preparations - study of substrates. Study of the growth of polycrystalline layers (liquid phase in tin flux).

ADDENDA: Performing organization: Laboratoire D'Electronique et de Physique Appliquee L.E.P. SA.

SUPPORTED BY France - General Del. Sci. & Tech. Res.

8.0014, INVESTIGATIONS OF SURFACES AND INTERFACES USING OPTICAL EXCITATION OF SURFACE PLASMONS

E. ABELES, Univ. of Paris, Lab. of Optical Solids, *Paris, France* (DA0C9366; DAERO 75 G0027)

To study metal-electrolyte and metal vacuum interfaces under various conditions so as to understand what goes on at these surfaces in phenomena such as electrolytic reactions, certain catalysis reactions, and certain energy reflectance effects at surfaces. Information on this subject is expected to have application in a wide variety of areas, particularly in better battery and fuel cell design and in development of surfaces where reflectance of energy under specified conditions is of importance such as in some high-energy laser applications.

A new, very sensitive method for surfaces and interfaces studies, combining ellipsometry and optical excitation of surface plasmons, will be applied in two areas. First, in the investigation of metal- electrolyte interfaces, electric field effects at the interface, which play a crucial role in electroreflectance experiments on metals, as well as oxygen adsorption on the metallic anode will be considered. Secondly, the same method will be applied to investigations of adsorption and diffusion phenomena on clean surfaces of metallic films and single crystals under ultra-high vaccum. Metallic (noble and transition metals) as well as gaseous adsorbed species on different metals will be studied.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Research & Standardization Group (Europe), Box 65, FPO, N.Y. 09510. Performing Organization: Universite de Paris, Laboratoire d'Optique.

SUPPORTED BY U.S. Dept. of Defense - Army

8.0015, OPTICAL PROPERTIES OF SEMICONDUCTORS UNDER VERY HIGH PRESSURES

M. BALKANSKI, Univ. of Paris, *75 Paris 5e, France* (DA0C9390; DAERO 75 G0059)

This research is to study the effects of very high pressures on electronic states and lattice modes in solids up to pressures in the 50 - 100 kilobar region. In particular, studies concerning the nature of impurities will be undertaken to determine the crystal structure around the impurity sites, the nature of the bonding between the impurity and its nearest neighbors, and the phonon density of states. Such investigation is required if we are to attempt to understand the true nature of impurities in the solid state, particularly in layer-type semiconductrs.

Recent advances using diamond anvil-type presses in conjunction with optical and Raman spectroscopic techniques have allowed preliminary experiments to be performed at pressures up to 40 kilobars. Variations of pressure coefficients of different vibrational modes have been observed in zinc sulfide containing manganese by Raman techniques. This research intends to develop and explore this and related techniques gaining an order of magnitude increase in pressure over the current 10 kilobar work.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AMC European Research Office, Box 15, New York, N.Y. 09510

SUPPORTED BY U.S. Dept. of Defense - Army

8.0016, INTERACTION OF RADIATION WITH MATTER 11332-P

S.T. MANSON, Georgia State University, School of Arts & Sciences, *Atlanta, Georgia* 30303 (DA0E8953; DAHC04-74-G-0217)

To perform reliable calculations of cross sections for photoionization of multicharged positive ions of atmospheric gases and stopping power calculation of charged particles. The results of this study should enhance the understanding of the effects of a nuclear blast in the atmosphere, nuclear hardening of electronic components, the propagation of coherent X-rays in the atmopshere, and computer simulation of preionization in an E-beam laser medium.

Examine validity of Born approximation, include correlation effects, use generalized oscillator strengths and calculate individual atomic subshell contributions to: A. photoeffects; (a) photoelectron angular distribution; (b) photoionization cross sections of multicharged postive ions. B. Fast charged particle effects: (a) energy and Z- dependence of angular distribution of ionized electrons (delta rays); (b) total ionization cross section, stopping power.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0017, HIGH-ENERGY ACCELERATOR AND COLLIDING BEAM USER GROUP

R.G. GLASSER, Univ. of Maryland, School of Arts & Sciences, *College Park, Maryland* 20742 (E-(40-1)-2504)

The aims of this high-energy physics research program are to devise and to carry experiments that will uncover and elucidate the properties of 'elementary particles' and their interactions. Strong, electromagnetic and weak interactions are studied using many techniques including counters, spark chambers and bubble chambers.

In strong interactions, the program includes: analysis of proton- proton and negative pion-proton collisions from 100 to 360 GeV/c using bubble chamber hybrid system or, alternatively, the 15' bubble chamber at Fermilab; a high-statistics positive kaon-proton inelastic cross- section experiment at 1.6-1.9 GeV/c.

In electromagnetic interactions, analysis of a SPEAR positron- electron experiment at the psi, psi', 4 GeV and 6-7 GeV regions with emphasis on gamma-ray emission and inclusive muon and hadron spectra; study of positron-electron collisions at 1-2 GeV with MEA at ADONE; design and development of a detector facility for PEP.

In weak interactions, high-energy neutrino interactions with deuterium at Fermilab with special emphasis for charmed baryons; search for (positive muon, electron) yields (negative muon, positron) transitions at SREL, study of exotic neutrino reactions at Fermilab.

RESULTS: Recent contributions have included: evidence for anomalous, inclusive muon production in positron-electron collisions at 4.8 GeV for discrete gamma-ray lines from psi (3.7) decays, measurement of cross sections, multiplicities and correlations in negative pion- proton collisions at the highest available energy (360 GeV/c), characteristics of strange particle production in 100 GeV/c negative pion-proton collisions, properties of Xi* resonances and phi decays, improvements in widely used bubble chamber analysis programs and in the Md. PEPR, phenomenology of heavy lepton and charmed particle decays.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0018, PRODUCTION AND ANALYSIS OF THERMONUCLEAR PLASMAS IN HIGH BETA DEVICES

H.R. GRIEM, Univ. of Maryland, Graduate School, *College Park, Maryland* 20740 (AT(40-1)4514)

This is a proposal for the continuation of research that investigates, both theoretically and experimentally, a variety of plasma effects related to the equilibrium, stability, transport and radiation properties of high-temperature fusion plasmas. The theoretical investigations (Task I) are carried out in parameter regimes pertinent to existing and proposed DCTR experiments with particular emphasis on high-beta plasmas and Tokamak plasmas. As the Maryland high-beta experimental program moves into the long-time confinement regime (e.g., TERP), it is increasingly important that a major theory support effort on MHD equilibrium and stability studies be developed at the University of Maryland. The common goal of the various proposed experimental studies (Tasks II-VI) is to acquire a sound empirical basis for Maximum Beta Reactor design and development. Task II is mostly concerned with high-beta Tokamak confinement physics, using TERP-I and -II as test beds for studies of stability and transport up to approximately 1 msec. Task III concentrates on the production and heating of reactor-grade plasma by theta-pinch methods in toroidal geometry, using THOR. This heating study will be followed by a confinement program, with the short-term goal of catching and holding the plasma for approximately 30 micron sec. The development of measurements and instrumentation is to be carried forward in several directions, some of them continuations of ongoing research (Task IV) and one a new direction (Task V). The goal of this new program is to develop diagnostics for the measurement of deuterium and hydrogen atom concentrations near the edges of fusion plasmas. In Task VI, we propose to resume our measurements of impurity radiation to provide a data base for Tokamak simulation codes.

SUPPORTED BY U.S. Energy Res. & Dev..Admin. - C.T.R.D.

8.0019, SPACE CHARGE EFFECTS IN SEMICONDUCTORS

A.L. WARD, U.S. Army, Harry Diamond Laboratories, *Hyattsville, Maryland* 20783 (DA0A5746)

The technical objective is the understanding of the transient behavior of space charge in semiconductor devices. An existing computer program is used which permits the simulation of two-terminal devices. The principal emphasis is on Gunn oscillators and avalanche devices.

The computer program is used to solve the nonlinear transport equation with space-charge limitation. Pulse transport, including recombination and diffusion, is studied as a function of doping level and applied field. Gunn oscillations are studied for a specific variation of drift velocity with electric field. Electrical breakdown and avalanche oscillations are studied for arbitrary junction profiles in semiconductors. Calculations are guided by comparison with experimental measurements made in these laboratories and elsewhere.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Harry Diamond Lab., 2800 Powder Mill Road, Adelphi, Md. 20783

SUPPORTED BY U.S. Dept. of Defense - Army

8.0020, NUCLEAR STRUCTURE THEORY

K.T. HECHT, Univ. of Michigan, School of Liberal Arts, *Ann Arbor, Michigan* 48104 (PHY75-18443 A01)

Research initiated under NSF grant GP-25864, Amendment 1, will be continued. Among the topics in nuclear structure theory to be investigated are: (1) spectroscopic amplitudes for few-nucleon transfers in heavy-ion reactions, and gamma-clustering phenomena, (2) the use of special coupling schemes, in particular the pseudo SU3 model, in a study of the properties of high spin states and the phenomenon of decoupled h11/2, and I13/2 bands, (3) use of the spectral distribution technique as a tool in testing the goodness of nuclear symmetries.

SUPPORTED BY U.S. Natl. Science Foundation

8.0021, MECHANISMS FOR AMORPHOUS STATE FORMATION IN ION IMPLANTED SILICON 12676-P

E. HALE, Univ. of Missouri, School of Arts & Sciences, *Rolla, Missouri* 65401 (DA0A5576; DAHC04-75-G-0062)

To determine and better characterize the relevant mechanisms involved in the amorphization of silicon by ion implantation by performing experiments designed and motivated to improve and understanding of ion-implanted materials. There exists considerable military and commercial interest in high-density integrated-circuit technologies. Objectives are being met by various schemes of oxide isolation, sometimes in combination with

SOS. Ion-implanted amorphous layers, if stable, would have a significant advantage over oxide produced in buried layers without transforming the surface layer. Increased understanding of the mechanisms involved in the amorphization by implantation will help to advance future ion implantation technologies.

Electron spin resonance will be used as the research tool to study the formation mechanisms. Samples will be studied under various implantation conditions including ion specie, ion energy, dose, dose rate, implant angle and sample temperature. Proposed theoretical models will be compared to determine their range of validity.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0022, ELECTRONS IN COMPLEX SOLIDS

D.J. SELLMYER, Univ. of Nebraska, School of Arts & Sciences, *Lincoln, Nebraska* 68508 (DMR76-17417)

Investigation of electronic and magnetic states in relatively complex solids previously supported by NSF grant DMR72-03208 will be continued. These materials either exhibit new types of physical phenomena or require new theoretical models for their understanding. Several classes of problems will be studied; (1) complex ordered solids; (2) spin-polarized electron states in metallic compounds; (3) localized moments and magnetic clusters in dilute alloys; and (4) electronic and magnetic states in amorphous metallic alloys. The experimental work will consist of de Haas-van Alphen measurements, in fields up to approximately 100 kG, in a super-conducting solenoid, and high-field magnetoresistance measurements on selected compounds. In systems where localized magnetic moments or magnetic phase transitions are involved, electron transport, magnetic susceptibility, and high-field magnetization measurements will be performed. The results should contribute to our understanding of (1) the relationship between electronic structure and chemical bonding in structures where the bonding is poorly understood, (2) the localized-moment and itinerant- electron aspects of magnetism in conducting solids, (3) the nature of the magnetic interactions and clusters in some two-dimensional and sd- band metals, and (4) the dependencies of the electronic and magnetic properties of glassy metals on fluctuations of exchange constants, local anisotropy, charge transfer, and structural effects.

SUPPORTED BY U.S. Natl. Science Foundation

8.0023, INVESTIGATIONS OF PLASMA DYNAMICS

G. SCHMIDT, Stevens Institute of Technol., Graduate School, *Hoboken, New Jersey* 07030 (E(11-1)-3004)

ANALYTICAL: Wave heating of plasmas in an inhomogeneous medium will be investigated. In particular, lower hybrid wave heating in Tokamak-type devices will be studied, with particular emphasis on parametric decay processes involving drift waves. Inhibition of strong parametric coupling (to avoid surface heating) using pump modulation will also be studied.

COMPUTATIONAL: Symbol manipulation by computer will be applied to the study of waves and instabilities in plasmas. Particular application will be made to problems connected with RF heating of thermonuclear plasmas with special attention to be paid to the spatial aspects of linear propagation and parametric instabilities.

RESULTS: Latest results include a study on nonlinear saturation of nonlinear Landau damping-type instabilities. We have proved that the spectrum approaches an equilibrium in the presence of source terms. This equilibrium spectrum has been calculated.

A calculation of lower hybrid wave filamentation as applied to Tokamak-type plasmas has been performed.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - C.T.R.D.

8.0024, MOSSBAUER EFFECT STUDIES IN CHEMISTRY AND SOLID-STATE PHYSICS

R.H. HERBER, Rutgers the State University, School of Chemistry, *New Brunswick, New Jersey* 08903 (DMR76-00139 A01)

This grant will provide partial support for two distinct but closely related studies, both utilizing Mossbauer effect methodology in the elucidation of the structure, bonding and solid-state properties of organometallic molecules and related compounds.

In the first part, the effective vibrating mass model (EVM) proposed earlier, which permits a correlation between Raman active lattice vibrational modes and the temperature dependence of the recoil- free fraction (Mossbauer Debye Waller factor) observed in Mossbauer experiments, is extended and subjected to a critical test by isotopic substitution in SnH_4.

In the second part, Mossbauer effect spectroscopy is used to study the lattice dynamics, vibrational anisotropy, bonding and charge distribution in an important new class of materials, the intercalated layer compounds of TaS_2 and related transition-metal dichalcogenides. Such studies are expected to elucidate the interaction between the intercalated molecule and the host material, and in this manner provide a new and unique probe into the solid-state properties of these metallic and semiconductor materials.

SUPPORTED BY U.S. Natl. Science Foundation

8.0025, FREE SURFACE PROPERTIES OF III-V COMPOUND SEMICONDUCTORS 11671-EL

P. MARK, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DA0D9277; DAHC04-74-G-0133)

To investigate free surface properties of III-V compound semiconductor materials. Relevance - a better understanding of electronic surface states in III-V compounds is recognized as a high- priority item in the TCP on electron devices. Army laboratory evaluators mention potential impact on MOS transistors for extremely high frequencies on the development of third-generation photocathodes in night-vision devices and on the understanding of surface stability of high-energy materials for explosives application.

The following properties will be investigated: (1) the reconstruction of polar faces through LEED analyses; (2) the stability of the various ordered nonpolar and polar surfaces through LEED and Auger electron spectroscopy; (3) the trade-off between stability and surface order observed with the related II-VI materials through a combination of LEED, AES and electrical analyses.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Rsch. Office, P.O. Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0026, UV STUDIES OF A10-SI SYSTEM

R.J. POWELL, Radio Corporation of America, *Princeton, New Jersey* 08540 (DF900170; F19628-74-C-0132)

AF function - weapons delivery. Deficiency - current nuclear hardness requirements cannot be met by CMOS circuits. Research - investigate electron and hole trapping mechanisms in aluminum oxide insulator-silicon structures. How research contributes - an understanding of the relationship of trapping mechanisms to radiation and high-field-induced electron injection will allow aluminum oxide radiation-hardened dielectrics to be used on MOS circuits.

Interface photoinjection and trap photodepopulation with vacuum ultraviolet radiation will be used to study the nature, spatial distribution and energy distribution of trapped charge in aluminum oxide layers appropriate to MIS device structures.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0027, DEFECT STRUCTURE IN GAAS MATERIAL AND DEVICES

G. SCHWUTTKE, Internat. Bus. Machines Corp., *Hopewell Junction, New York* 12533 (DF900600; F19628-75-C-0174)

AF function - this research is related to the development and improvement of gallium arsenide devices. Deficiency - need to define the defect structure and failure mechanisms in gallium arsenide devices in relation to their operational capabilities. Objec-

tive - provide analysis of the defect structure of gallium arsenide materials, devices and failed devices as a function of bulk properties and processing parameters. How research contributes - characterization of defect structures in materials and devices may aid in the development of reliable gallium arsenide devices.

Surface and bulk properties of materials and devices will be measured primarily by X-ray topographic techniques. Transmission, scanning electron and reflection electron microscopy and electron microprobe techniques will also be applied. Electrical measurements such as Hall mobility and spreading resistance will be made. These techniques will be applied to materials and devices, to evaluate them before and after various processing steps, including after device failure.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0028, THEORETICAL SOLID-STATE PHYSICS - OPTICS, AND GROUP THEORY APPLICATIONS

J.L. BIRMAN, City University of New York, School of Arts & Sciences, *New York, New York* 10031 (DMR76-20641)

Research started under grant DMR74-21991 will be generalized and extended. Further application of group-theoretical methods to condensed matter physics will be made. In particular, aplication to structural distortions in A15 compounds and a study of the compatibility of superconductivity and ferroelectricity will be undertaken. Further work on a theory of amorphous tetrahedral compounds will also be done.

SUPPORTED BY U.S. Natl. Science Foundation

8.0029, ANGULAR RESOLVED SPECTROSCOPY OF SOLIDS - STRUCTURE AND ELECTRONIC PROPERTIES OF SURFACES

N.J. SHEVCHIK, State University of New York, School of Arts & Sciences, *Stony Brook, New York* 11790 (DMR75-21867)

Angular resolved X-ray and ultraviolet photoemission spectroscopy (XPS and UPS) experiments will be performed in a new ultra-high vacuum electron spectroscopy system featuring a concentric hemispherical electrostatic deflection-type electron velocity analyzer mounted on a rotatable table. Emphasis will be placed on the development of techniques for spectroscopic selection and polarization of radiation from gas discharge sources for use in angular resolved photoemission experiments. The feasibility of extending this technique to three- dimensional systems will be evaluated.

SUPPORTED BY U.S. Natl. Science Foundation

8.0030, THERMODYNAMIC PROPERTIES OF SOLID HYDROGEN AND DEUTERIUM UNDER HIGH PRESSURES 11317-P

H. MEYER, Duke University, School of Arts & Sciences, *Durham, North Carolina* 27706 (DA0D9082; DA-ARO(D)-31-124-73-G111)

To investigate the thermodynamic properties of solid hydrogen and deuterium under high pressure. Relevance - Watervliet Arsenal states that 'in addition to providing an important scientific insight to the physical properties of the molecular solid, the redetermination of the equation of state up to 20 kilobars will provide important low-pressure calibration data for use in the extreme-pressure (P equals .5 mbar) experimental studies to be performed at this arsenal. The genesis of this work is the possible metallic transformation of H sub 2 and its use as a high-temperature superconductor which could have significant technological implications.'

CW and pulsed NMR spectroscopy studies will be made of solid hydrogen and deuterium under various conditions of pressure to determine the pressure dependence of the electric quadrupole coupling and quantum diffusion. In addition thermodynamic properties will be measured in O to determine the equation of state at high pressures.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0031, INTERACTIONS BETWEEN ELEMENTARY PARTICLES AND NUCLEI, AND DEVELOPMENT OF DETECTED METHODS

W.D. WALKER, Duke University, School of Arts & Sciences, *Durham, North Carolina* 27706 (E(40-1)-3065)

We are studying high-energy pion-proton and pion-Ne collisions. The work is aimed at developing a quantitative understanding of pion production. Our work gives information about the processes going on at small distances and times. We are also studying the characteristics of diffraction dissociation processes. We propose to continue our work investigating the origin of processes giving rise to an energy unbalance. We propose to do additional experiments at SLAC on these processes. The work will involve the use of one of Hofstadter and Hughes' NaI crystals in addition to the 40-inch bubble chamber at SLAC. We also expect to extend our work at Fermilab to the interactions of high-energy pi's with a heavier nucleus such as uranium.

RESULTS: We have made measurements of single neutral pions distributions in positive pion, negative pion and pion-Ne collisions. We have made measurements for positive pions, negative pions, neutral pions, protons, of the distributions in momentum, rapidity in pion-Ne collisions. We have also made detailed studies of multiplicity resulting from pi-Ne collisions at energies of 10.5 and 200 GeV. One of our most interesting results is a deficit energy in the energy carried away by the known particles (positive or negative pions, p, short-lived neutral kaon, neutral pions). This is a very interesting and puzzling result.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0032, INVESTIGATION OF THE MECHANISMS OF EXOELECTRON EMISSION FROM INSULATING SOLIDS

E.E. KOHNKE, Okla. St. Univ., School of Arts & Sciences, *Stillwater, Oklahoma* 74075

The study of surfaces and insulating crystals as a means of fabricating improved radiation dosimeters, evaluating and controlling space charge effects in MOS-type circuit elements.

SUPPORTED BY Oklahoma State Government - Oklahoma City

8.0033, PHOTOCONDUCTIVITY STUDIES OF ZNO SINGLE CRYSTALS

G. SUMMERS, Okla. St. Univ., School of Arts & Sciences, *Stillwater, Oklahoma* 74075

Single crystals of ZnO, after irradiation with high-energy electrons that produce the 'b' optical band, are being checked for photoconductive properties.

SUPPORTED BY Oklahoma State Government - Oklahoma City

8.0034, TRANSPORT AND THERMODYNAMIC PROPERTIES OF MAGNETIC AND NEARLY MAGNETIC SYSTEMS

T.W. MIHALISIN, Temple University, School of Liberal Arts, *Philadelphia, Pennsylvania* 19122 (DMR76-16433)

Research supported under NSF grant DMR72-03172 will be continued. The thrust of the forthcoming investigations will be on investigating: (a) crystalline electric fields, (b) the role of the Kondo effect, (c) effects due to interconfigurational fluctuations on the transport and thermal properties of selected alloys. Among these alloys those of Ce, La, and Pr will be of particular importance. The extreme case of electric field effects, i.e., induced moment systems, will be emphasized. Here attention will be focused on compounds of Pr, Tb and La. The measurements to be made will include resistivity, susceptibility, ultrasonic attenuation and thermopower.

SUPPORTED BY U.S. Natl. Science Foundation

8.0035, STATISTICAL MECHANICS AND MATERIALS SCIENCE

J.F. NAGLE, Carnegie Mellon University, School of Arts, *Pittsburgh, Pennsylvania* 15213 (DMR72-03203 A02)

This project is concerned with two main problem areas: (1) phase transitions in biomembranes, lipid bilayers and polymers;

and (2) hydrogen bonded crystals, with an emphasis on the ferroelectric and antiferroelectric phase transitions in layered 'two-dimensional' crystals such as Cu (HCOO)2. 4H2O, NaH3(SeO3) and SnCl2.2H2O. The method of study involves theoretical modeling of the systems and performing statistical mechanical calculations, both approximate and exact. The object of these studies is to understand the physical and chemical mechanisms of the phase transitions and to calculate basic microscopic parameters from macroscopic measurements.

This is a continuation of research supported under DMR72-03203.

SUPPORTED BY U.S. Natl. Science Foundation

8.0036, CRITICAL PHENOMENA AND PHASE TRANSITIONS

D.M. JASNOW, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (DMR76-19443)

Research pursued under grant DMR73-02552 will be continued and extended. High-temperature series methods previously employed for calculating thermodynamic quantities near ordinary critical points will be extended to bicritical points, including calculations of the cross- over functions which describe the change from one sort of critical behavior (Heisenberg) to another (Ising). Phase diagrams of systems with competing ferromagnetic and antiferromagnetic interactions will be contructed with the aid of the renormalization group.

SUPPORTED BY U.S. Natl. Science Foundation

8.0037, INVESTIGATION OF METASTABLE SUPERCONDUCTING MATERIALS 10852-MC

R.D. BLAUGHER, Westinghouse Electric Corp., *Pittsburgh, Pennsylvania* 15235 (DA0D9103; DAHC04-73-C-0018)

To determine the relationship between the superconducting transition temperature and the stoichiometry, long-range atomic ordering, and defects of Type A 15 compounds and alloys. Superconducting materials could be used in surveillance and communications equipment to improve performance because of their low energy loss and low-noise operation. The attendant reduction in size and weight could decrease operating cost and increase efficiency of motors and generators. Transmission and conversion of electrical power would thus benefit.

Research will be concerned with: (1) study of the effects of processing temperature up to 1500 degrees C, pressure to 70 kbar, and time to 700 hours on atomic ordering, absorbed gases, and concentration and type of defects present; (2) determination of the composition- temperature-pressure constitution diagrams for the Nb-Ga, Nb-Ge, and Nb- Al-Ge superconducting systems.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0038, FIELD ION MICROSCOPE INVESTIGATIONS OF GROUP VIII AND IB METAL SURFACES

T.T. TSONG, Penn. State University, School of Science, *University Park, Pennsylvania* 16802 (DMR76-11418)

The electronic and atomic properties of Group VIII and IB metal surfaces (Fe, Co, Ni, Ru, Rh, Pd and Cu, Ag, Au) will be investigated utilizing the atomic resolution of the field ion microscope (FIM). The distribution of the frequency of finding various bond lengths between two interacting atoms, the association-dissociation behavior of clusters, and the directional walk of single atoms in non-uniform electric fields will be investigated. Field evaporation rates of single atoms from various high-melting metals as well as some liquid metals will be measured without the interference of an imaging gas. The surface segregation of alloy species upon annealing in vacuum, making particular use of the high mass resolution of our energy-focusing time- of-flight atom-probe will be studied. The crystallographic specificity of the formation of metal compounds with adsorbed common gases, using Group VIII pure metals as well as alloys, will be determined. Field- induced dissociation and surface reactions will be particularly studied with nitric oxide. This information is important for the development of a microscopic understanding of various surface phenomena, such as adsorption, corrosion and catalytic activity.

SUPPORTED BY U.S. Natl. Science Foundation

8.0039, SOLID STATE AND MANY-BODY THEORY

L.N. COOPER, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DMR73-02605 A01)

This research program is a continuation of that supported by NSF grant DMR73-02605 and is concerned with a number of problems in condensed matter and many-body theory. Research will continue on the theory of transport properties, particularly the surface impedence, of pure type II superconductors both above and below the transition temperature in a magnetic field. The nature of the spin interactions in the condensed phases of helium-3, particularly the B phase, will be examined where the aim will be to theoretically describe the 'orbital waves' (a wavelike motion of the preferred direction in the anisotropic pairing state) which have been predicted. New methods for applying the renormalization group techniques to the calculation of critical point phenomena will be further explored. Also the properties of a one- dimensional electron gas in which large momentum change back-scattering processes are allowed will be studied theoretically.

SUPPORTED BY U.S. Natl. Science Foundation

8.0040, ELECTRONIC STRUCTURE AND STABILITY OF METALLIC GLASSES 13723-P

J. TAUC, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DA0E9132; DAAG29 76 G0221)

Develop theoretical and experimental understanding of the influence of the electron gas on the stability of metallic glasses. Relevance - metallic glasses prepared by fast quenching of some alloys have many valuable properties of technological importance. Among these outstanding characteristics are high strength, ductility, corrosion resistance and simplicity of production. Increased understanding of the mechanisms which control the stability of these and other systems is crucial to the ultimate exploitation of their potential.

A test of the basic assumptions of an electron theory of metallic glasses will be made by a variety of experiments including ultraviolet photoemission, optical properties, magnetic susceptibility, transport properties and inelastic neutron scattering. An attempt will be made to extend the present theory to other classes of alloy systems.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0041, GAS-SOLID INTERACTIONS AT SEMICONDUCTOR SURFACES

J.H. LUNSFORD, Texas A & M University System, School of Science, *College Station, Texas* 77843 (CHE75-15456 A01)

Electron paramagnetic resonance (EPR) spectroscopy has been used to identify the ions O minus, O minus sub 2, and O minus sub 3 on the surface of certain metal oxides; yet, the role of these ions in partial and complete catalytic oxidation has not yet been established. Detailed observation will be made to determine the reactions which occur between these ions and representative hydrocarbons. Surface intermediates will be identified where possible. Both the product distribution and reaction rates will be determined. This work will include a study of the ozonide ion with respect to its role in photocatalytic oxidation reactions. As a model of a truly catalytic system molybdenum oxide supported on silica gel will continue to be investigated for oxidation and oxidative dehydrogenation reactions. The relative differences in reactivity and selectivity between surface O minus, O minus sub 2, and O to the 2 minus power ions will be determined. Photoelectron spectroscopy will be applied to identify oxygen species on metal oxide surfaces. This work should provide a model for understanding the general problem of catalytic oxidation reactions. This work is a continuation of that currently supported by Foundation grant GP-35662X.

SUPPORTED BY U.S. Natl. Science Foundation

8.0042, ELECTRON GAS IN SEMICONDUCTORS IN EXTERNAL ELECTRIC AND MAGNETIC FIELDS

J. ZAK, U.S. Army, Research & Development Group, *London, England, United Kingdom* (DA0B9456; DAERO 75 G0061)

Investigation of the behavior of an electron in semiconductors in the presence of a perturbation is to be carried out. Results of this work will influence the design of militarily useful devices, i.e., solid-state diodes, transistors, electrooptic devices such as Gunn and Impatt diodes, and microwave transistors.

Research will be continued on further development of the description of the motion of electrons in solids in the presence of external fields. The problems of impurities in semiconductors, the electrooptical absorption and the significance of symmetries in the presence of an external magnetic field will be investigated. Both the KQ-representation method and the spectral-density operator approach will be used. Particular attention will be paid to the investigation of the stability of bands in the presence of external perturbations.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Research & Standardization Group (Europe), Box 15, FPO, N.Y. 09510

SUPPORTED BY U.S. Dept. of Defense - Army

8.0043, MAGNETIC RESONANCE STUDY OF ATOMIC AND MOLECULAR MOTIONS

D.C. AILION, Univ. of Utah, School of Science, *Salt Lake City, Utah* 84112 (DMR76-18966)

The program of investigation of atomic and molecular motions by means of nuclear magnetic resonance previously supported by NSF grant DMR72-02924 will be continued. Recent theoretical and experimental work of the principal investigator and previous students suggests that under appropriate conditions it may be possible to use NMR to distinguish between different diffusion mechanisms. Previously, this work verified experimentally these ideas for the case of Cl vacancy diffusion. These experiments will be extended to cases in which other types of diffusion dominate. A study of the diffusion of interstitial F ions in pure and doped CaF2 single crystals has been completed. These measurements will be extended to CaF2 crystals doped with Na ions, in which F vacancies dominate. Calculations of the angular dependence of the low-field rotating frame relaxation time for different modes of reorientation of the NH4 ions in NH4Cl have been completed. Also, the temperature and angular dependence of T1 degree have been measured. These techniques will be applied to a study of rotation in more complicated systems, like trans-trans muconodinitrile and para-terphenyl, which have an energy profile having several shallow minima corresponding to different orientations of the molecule. Techniques are being developed for combining ultraslow motion methods with double resonance for the purpose of studying the motions of weakly magnetic or dilute spins directly. NMR relaxation time measurements will be used to study ionic diffusion in solid electrolytes, like sodium beta and beta' alumina. Because of the very high conductivity of Na ions in beta and beta' alumina, these substances have a variety of applications in problems where energy conversion is important.

SUPPORTED BY U.S. Natl. Science Foundation

8.0044, PROPERTIES OF DILUTE MAGNETIC ALLOYS AT VERY LOW TEMPERATURES AND NUCLEAR COOLING

O.G. SYMKO, Univ. of Utah, School of Letters & Science, *Salt Lake City, Utah* 84112 (DMR76-21702)

Experimental studies of dilute magnetic impurities at very low temperatures previously supported by NSF grant DMR71-01802 will be continued. The interest is in the behavior of transition-metal impurities in a non-magnetic metal host. Such impurities will interact strongly with their surroundings, and in particular they will interact with the crystalline field produced by the surrounding ions and conduction electrons, with the conduction electrons, and with the other impurities; also, hyperfine interactions and a spin-compensated Kondo state can exist. These effects will be studied by measuring the magnetization as a function of temperature in the following alloys: Zn- Cr, Mg-Mn, Au-Mn, and Cu-Cr. As impurity-impurity interactions are quite strong, it will be necessary to go to very low impurity concentrations to observe some of the above mentioned single-impurity effects. The latter tend to be weak and hence low temperatures are necessary to reduce the thermal energy kT. A nuclear cooling apparatus together with a SQUID magnetometer will be used to study the ground- state behavior of some of the above alloys and nuclear quadrupole interactions in metals.

SUPPORTED BY U.S. Natl. Science Foundation

8.0045, THEORETICAL STUDIES IN DISORDERED SOLIDS

E.N. ECONOMOU, Univ. of Virginia, School of Arts & Sciences, *Charlottesville, Virginia* 22903 (DMR76-19458)

Research on the theory of electronic states in disordered systems previously supported by NSF grant DMR72-03279 will be continued. The proposed research falls in three topical areas. The first area includes the calculation of thermodynamic and transport quantities of physical systems where electron-electron interactions and randomness are present. Emphasis will be placed on one-dimensional systems with the ultimate goal of studying one-dimensional conductors and on the influence of an external magnetic field on the thermodynamic and transport properties of three-dimensional systems. The second project will be a study of the role of surface plasmons in superconductivity for metallic particles embedded in a semiconducting matrix. The third project will consist in a theoretical study of materials which undergo local structural transformations, e.g., tungsten bronzes, amorphous metallic films, PdH, etc. In particular, the role of these modes in promoting superconductivity will be examined.

SUPPORTED BY U.S. Natl. Science Foundation

8.0046, INTERACTING EXCITATIONS IN CONDENSED MATTER

J. RUVALDS, Univ. of Virginia, School of Arts & Sciences, *Charlottesville, Virginia* 22903 (DMR76-80154)

Research previously supported by NSF grant DMR72-02972 will be continued. An extension of the present theoretical research program to study various aspects of interacting excitations will be made for the following systems: I. Microscopic Theory of Excitations in Quantum Liquids. II. Plasmon Interactions in an Electron Gas. III. Plasmon Modes in Systems of Reduced Dimensionality. IV. Phonon Interactions and Phase Transitions in Solids.

SUPPORTED BY U.S. Natl. Science Foundation

8.0047, STATISTICAL MECHANICS OF SIMPLE SYSTEMS

L.W. BRUCH, Univ. of Wisconsin, School of Natural Sciences, *Madison, Wisconsin* 53706 (DMR74-19826 A01)

This work extends that carried out under NSF grant DMR74-19826. The overall thrust of this research is to apply various methods of statistical mechanics to atomic and simple molecular systems. Calculations will be based on models constructed from the best experimental and theoretical information available and will produce values for thermophysical properties that can be compared with experimental values. A number of specific types will be addressed, overlapping both low-temperature physics and chemical physics. These include: (a) Monolayers of xenon adsorbed on silver surfaces, (b) Non- additive intermolecular forces, e.g., three-body forces in helium and neon at short separation, (c) Polarizability of an inert gas diatom, (d) Binding energies of clusters of atoms, obeying both Bose and Fermi statistics, (e) Response functions for liquid helium in the range of momentum transfer applicable to Raman and neutron scattering experiments.

SUPPORTED BY U.S. Natl. Science Foundation

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, RADIO ASTRONOMICAL STUDIES

W.J. WELCH, Univ. of California, School of Engineering, *Berkeley, California* 94720 (AST75-13511 A02)

Detailed observations of molecules in the galaxy will be continued with the millimeter-wave interferometer. Studies will be made of water vapor, methanol and cyanogen clouds in interstellar space. Detailed information of the position and extent of these clouds will help to define their relationship to the process of star formation. The physical conditions within the water vapor clouds will be probed to determine the mechanism by which they act as large-scale natural maser amplifiers. The planets and sun will be observed with a clarity of detail never before achieved at these wavelengths.

The 85-foot telescope which works mostly in an automatic mode will continue to be used for survey projects and at one station in the intercontinental Very Long Baseline Interferometry Network.

The 62-inch submillimeter telescope on White Mountain will be modified for Cassegrain use and equipped with a new type of bolometer. In a cooperative program with scientists at the California Institute of Technology, a pioneering program of submillimeter observations will be undertaken.

This is a continuation of research supported by NSF grant AST- 7513511.

SUPPORTED BY U.S. Natl. Science Foundation

10.0002, STUDIES OF SOUTHERN RICH CLUSTERS OF GALAXIES

G.O. ABELL, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (AST76-03438)

Dr. G. Abell will spend the academic year 1976-77 in Edinburgh, Scotland, at the invitation of Professor Vincent Reddish, to study rich clusters of galaxies revealed on the plates now being taken with the 48- inch Schmidt telescope at the Siding Springs (Australia) Observatory for the Southern Hemisphere Sky Survey. The plan is to prepare a catalog of southern clusters, similar to Abell's catalog of northern clusters found on the plates taken for the Palomar Sky Survey. The southern catalog should reach fainter magnitudes, and hence more distant clusters. That sample of clusters that meets as nearly as possible the same criteria used to select the homogeneous sample of 1682 clusters in the northern survey will be selected for study. With this new, enlarged statistical sample, now including the entire sky, he expects to extend the study of the large-scale and small-scale isotropy and hemogeneity of matter in space to the Southern Hemisphere.

SUPPORTED BY U.S. Natl. Science Foundation

10.0003, THEORETICAL AND OBSERVATIONAL STUDIES IN STELLAR AND GALACTIC ASTROPHYSICS

E.M. BURBIDGE, Univ. of California, Graduate School, *San Diego, California* 92037 (AST74-19239 A02)

The theoretical and observational research will involve investigations on several topics in stellar and galactic astrophysics. The main topics are: A. Theoretical: 1. Physics of circumstellar and interstellar grains of nonthermal sources, and evolution of observed spectra with time. 2. Interpretation of results of submillimeter observations of HII regions, 3. Interpretation of observations of the nucleus of our galaxy and nuclei of other galaxies, B. Observational: 1. Variability at different wavelengths of nonthermal sources such as BL Lac, 2. Variability of infrared radiation due to grains surrounding peculiar sources from 2 u and 10 u sky surveys, 3. Spectrophotometry of IRC and CRL infrared sources with delta 2 over 2 equals 0.01 spectral resolution, 4. Energy distribution of peculiarly infrared objects. C. Instrument Development: 1. A dispersing infrared spectrophotometer is being developed for use on the Mt. Lemmon telescope; 2. Further development of infrared photoconductor and photovoltaic detector systems, including arrays.

SUPPORTED BY U.S. Natl. Science Foundation

10.0004, IONIZED GAS IN NEBULAE, GALAXIES, AND QUASARS

D.E. OSTERBROCK, Univ. of California, Graduate School, *Santa Cruz, California* 95060 (AST76-18440)

Seyfert galaxies and radio galaxies, star systems in which large amounts of energy are released, will be studied spectroscopically using the Lick Observatory 120-inch telescope. Accurate quantitative spectra will be taken of these objects and analyzed to try to learn about the physical conditions, how the large velocities of the gas observed in these objects are maintained, and how the energy that makes them radiate light is fed into the gas. The measurements made with the spectral scanner on the telescope will be compared with theoretical calculations in an effort to test our ideas and, if possible, to find out observationally which of them can be narrowed down and better specified, and which can be eliminated from consideration. A more definite picture of the energy sources in galaxies will emerge.

SUPPORTED BY U.S. Natl. Science Foundation

10.0005, STELLAR PULSATION THEORY

D.S. KING, Univ. of New Mexico, School of Arts & Sciences, *Albuquerque, New Mexico* 87106 (AST76-15445)

The research to be performed can be divided into four parts. (1) The Stellingwerf limit cycle stability analysis technique will be adapted to existing hydrodynamic computer codes. This method will be applied to a study of the double mode classical cepheid variable stars; (2) A study will be carried out of the model preference of classical cepheid stars at the point where past computations have been unable to follow the switching from one pulsation mode to another. It is important to note that a better knowledge of the pulsational mode of a cepheid is crucial in a determination of the correct period-luminosity- color relation; (3) There are several classes of variable stars which cannot be adequately modeled using only the standard time integration techniques. One such group is the Delta Scuti variable stars. These stars show best phenomena in their light curves and appear to be excited in more than one mode of pulsation. Using the new limit cycle stability analysis, it should be possible to determine whether those stellar parameters currently proposed for these stars will indeed lead to the observed variability; (4) The pulsational stability of massive stars near the upper end of the main sequence will be studied. This will give an indication of the limiting mass for main sequence stars.

SUPPORTED BY U.S. Natl. Science Foundation

10.0006, AERODYNAMICAL PHENOMENA IN STARS

N.H. BAKER, Columbia University, Graduate School, *New York, New York* 10027 (AST76-08917)

Research will be carried out on a project to compute the effects of an extensive outer convection zone on the pulsations of cool stars. The technique will be applied to cepheid variable stars and to other types of pulsating variable stars near the red (cool) boundary of the instability strip. The boundary separates stars which do and do not pulsate, a physical expansion and contraction of the stellar atmosphere. Computer codes will be developed for nonlinear periodic pulsations. The codes will be applied to understanding the pulsating variable star structure and behavior. A model will be developed for the early-type (hot) variable star Alpha Cygni which will discuss the mass loss of this object. Alpha Cygni appears to undergo multiple-periodic nonradial oscillations. More detailed and realistic physics will be employed in the improvement of previous calculations of models of the expanding dusty envelopes of cool carbon stars. The computations and modeling that will be carried out will enhance our understanding of mass loss by pulsating variable stars.

This is a continuation of work previously supported by NSF grant AST 71-03279.

SUPPORTED BY U.S. Natl. Science Foundation

10.0007, FIELD SEARCH FOR METEORITES, MCMURDO ICE-FREE AREA

W.A. CASSIDY, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (DPP76-10800)

The University of Pittsburgh will investigate areas of glacial ablation, moraines, and other areas of accumulation in Antarctica for meteorites. The Japanese Antarctic Expeditions have found very large numbers of meteorites in areas of glacial ablation near the Yamato Mountains of East Antarctica. Dr. William Cassidy of the University of Pittsburgh will investigate similar areas of potential meteorite accumulation in the McMurdo area of Antarctica. The goal of this project is to understand better the depletion areas of continental ice caps and to search for meteorites that may have fallen on the Antarctic Ice Cap in the past.

Two University of Pittsburgh scientists will do field research in the McMurdo area, Antarctica, during the 1976-77 summer season.

SUPPORTED BY U.S. Natl. Science Foundation

10.0008, THE RELATIONSHIP OF MACROTURBULENCE TO CHROMOSPHERES IN EARLY- AND LATE-TYPE STARS

M.A. SMITH, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (AST76-08471)

It has become widely accepted during the last two decades that chromospheres and coronas are associated with F, G, and K stars. Studies suggest that the corona evaporates and produces a 'stellar wind.' This wind carries magnetic plasma into interstellar space and exerts a torque on the star, thereby braking its rotation on a time scale of nearly one billion years. A significant related discovery was that the width of one of the primary chromospheric indicators, the reversal of the calcium II K-line, was correlated with the star's absolute visual magnitude. Our sun also fits an extension of this correlation, the Wilson-Bappu effect. Further, information about the solar chromosphere, corona, and the solar wind is consistent with this 'spin-down' picture derived from stellar observations. The onset of these chromosphere phenomena coincides with the development of an extensive stellar convective envelope. To the astronomical spectroscopist this convection manifests itself as 'macroturbulence', or photospheric turbulent or streaming motions over a large scale length. This research is designed to study the relationship between macroturbulence and chromospheric activity. High-resolution digicon observations of sharp-lined stars of different kinds will be made. Fourier deconvolution techniques will be used to separate the rotational and macroturbulent velocity fields. The size and character of the photospheric macroturbulent field will then be compared to various chromospheric indicators. The work will provide added insight to our understanding of the behavior and evolution of stellar atmospheres for solar-type stars.

SUPPORTED BY U.S. Natl. Science Foundation

10.0009, STUDY OF MAGNETOSPHERIC PLASMAS AT LUNAR DISTANCES

J.W. FREEMAN, Rice University, Graduate School, *Houston, Texas* 77001 (ATM74-21333 A02)

The Rice University Suprathermal Ion Detectors (SIDE's) were deployed on the moon during the three Apollo landings and have provided quantities of data on the magnetic particle environment of the earth and the moon. This grant will support the analysis of SIDE data on the protons observed at the lunar orbit. In particular, the appearance of energetic protons associated with the boundary between the magnetosphere and the interplanetary medium will be investigated. A major objective of this study will be to discover the origin of these particles.

A second study concerns the newly discovered plasma region known as the 'lobe plasma.' The observations in this magnetotail plasma will be correlated with other geophysical parameters in order to investigate its role in magnetospheric dynamics, e.g., what is its behaviour during a magnetospheric substorm.

SUPPORTED BY U.S. Natl. Science Foundation

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N77-10995*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT-TRANSFER DISTRIBUTIONS ON A 0.013-SCALE SHUTTLE SOLID ROCKET BOOSTER AT MACH 3.70 AND ANGLES OF ATTACK FROM 0 DEG TO 180 DEG
Milton Lamb and Robert L. Stallings, Jr. Washington Nov. 1976 33 p refs
(NASA-TM-X-3417; L-11011) Avail: NTIS HC A03/MF A01 CSCL 20D

An experimental investigation was conducted in the Langley Unitary Plan wind tunnel to estimate the peak aerodynamic heating on the space shuttle solid rocket booster during the descent phase of its flight. Heat transfer measurements were obtained using 0.013 scale models instrumented with thermocouples at a Mach number of 3.70, Reymolds number per meter of 11.48 million, and angles of attack from 0 to 180 deg. At angles of attack of 0 and 180 deg, heat transfer measurements on the cylindrical section of the model between the conical nose and ring interaction region were in good agreement with flat plate strip theory for laminar and turbulent flow. At angles of attack up to 30 deg, measurements on this section of the model were in good agreement with laminar swept-cylinder theory, whereas at angles of attack from 120 to 180 deg, the measurements were in good agreement with turbulent swept-cylinder theory. The good agreement with turbulent theory indicated that large flow disturbances created by the nozzle and afterbody flare at these large angles of attack influenced the downstream heating primarily by promoting boundary layer transition. Measurements obtained at 90 deg angle of attack were indicative of laminar flow. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N77-10996 New Mexico Univ., Albuquerque.
NUMERICAL INVESTIGATION OF THE FLOW OF A STRATIFIED FLUID PAST A FLAT PLATE Ph.D. Thesis
David Loren Eddingfield 1975 152 p
Avail: Univ. Microfilms Order No. 76-22143

The two dimensional stratified flow past a flat plate is investigated numerically. The coordinates are stretched with a hyperbolic tangent mapping in order to place the computational boundaries at a sufficiently large distance from the plate. The growth of a boundary layer from the back of the plate as reported by R. R. Long was confirmed numerically. The boundary layer is found to increase in thickness from the back of the plate for values of the ratio of the Reynolds number to the Richardson number up to at least 20. In addition, the upstream influence of the plate is found to decrease horizontally while spreading vertically in extent as the ratio of the Reynolds number to the Richardson number increases. Dissert. Abstr.

N77-10997*# Transemantics, Inc., Washington, D.C.
VISCOUS INTERACTION WITH SEPARATION IN TRANSONIC FLOW
J. Delery, J. J. Chattot, and J. C. LeBalleur NASA Aug. 1976 27 p refs Transl. into ENGLISH of ONERA conf. paper Presented at Flow Separation, AGARD Fluid Dyn. Symp., Goettingen, West Germany, 27-30 May 1975
(Contract NASw-2792)
(NASA-TT-F-17187) Avail: NTIS HC A03/MF A01 CSCL 01A

Strong viscous interactions which are present in transonic flows past airfoils give rise to an important thickening of the boundary layer with the frequent formation of a separated region. Under such conditions, the calculation of the flow must call upon rapid interaction theories whose application for the case of a turbulent boundary layer is examined in conjunction with experimental analysis. The experiments were conducted in a continuous wind tunnel equipped with a two dimensional nozzle having a 120 sq cm section. The experimental installation is made of a half profile mounted on the lower wall of the transonic channel. A detailed analysis of the flow field was made by using interferometry, a measuring technique which avoids any disturbance of the flow. At the same time, an effort was made to develop a method of calculation similar to Klineborg's approach. Author

N77-10998*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF JETS, WAKES, AND VORTICES ON LIFTING SURFACES
Richard J. Margason Nov. 1976 15 p refs Presented at the AGARD Flight Dyn. Panel Round Table Discussion Meeting, Moffett Field, Calif., 30 Sep. - 1 Oct. 1976
(NASA-TM-X-73974) Avail: NTIS HC A02/MF A01 CSCL 01A

The interaction of jets, wakes, and vortices on lifting bodies represents a broad spectrum of aerodynamic flow phenomena. A literature survey is presented of 79 research activities in related aerodynamic situations. Author

N77-10999# National Aeronautical Establishment, Ottawa (Ontario).
CONTROLLED AND UNCONTROLLED FLOW SEPARATION IN THREE DIMENSIONS
D. J. Peake Jul. 1976 70 p refs Presented at Symp. on Viscous Flows, Marietta, Ga., 22-23 Jun. 1976
(LR-591; NRC-15471; ISSN-0077-5541) Avail: NTIS HC A04/MF A01

The advantages of swept, sharp edges that generate controlled (or fixed) three dimensional flow separations on a vehicle - because of the qualitatively unchanging flowfield developed throughout the range of flight conditions are promoted in preference to

allowing uncontrolled (or unfixed) separations. The three dimensional viscous flowfields and vortical interactions about typical components such as delta wings and bodies at incidence are discussed, in apposition to their use on selected examples of current flight vehicles. Author

N77-11000*# Chrysler Corp., New Orleans, La. Space Div.
AERODYNAMIC CHARACTERISTICS OF A 0.00563 SCALE 142-INCH DIAMETER SOLID ROCKET BOOSTER (MSFC MODEL 449 AND 480) WITH SIDE MOUNTED STINGS IN THE NASA/MSFC 14-INCH TRISONIC WIND TUNNEL (SA14FA)
Paul E. Ramsey (NASA. Marshall Space Flight Center) Oct. 1976 293 p refs
(Contract NAS9-13247)
(NASA-CR-147645; DMS-DR-2325) Avail: NTIS HC A05/MF A01 CSCL 01A

An experimental investigation (SA14FA, TWT 620) was conducted in the MSFC 14-inch Trisonic Wind Tunnel (TWT) to determine the entry static stability of a 0.00563 scale shuttle solid rocket booster (SRB). The primary objective was to determine the effects of four side mounted sting configurations and to improve the definition of the aerodynamic characteristics in the vicinity of the SRB entry trim point. Data were obtained for two 60 and two 90 degree side mounted stings and a straight nose mounted sting. The angle of attack range for the side-mounted stings was 100 to 170 degrees while that for the nose mounted sting was 150 to 170 degrees. The Mach number range consisted of 0.6 to 3.48. Except for the aft attach ring, no protuberances were considered and the side slip and roll angles were zero. The test model was scaled from the 142-inch diameter SRB known as configuration 139 which was used during test TWT 572 (SA5F). Author

N77-11001*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT INVESTIGATION OF PILOTING TECHNIQUES AND CROSSWIND LIMITATIONS DURING VISUAL STOL-TYPE LANDING OPERATIONS
Bruce D. Fisher, Robert A. Champine, Perry L. Deal, James M. Patton, Jr., and Albert W. Hall Washington Oct. 1976 57 p refs
(NASA-TN-D-8284; L-10923) Avail: NTIS HC A04/MF A01 CSCL 05H

A flight research program was undertaken to investigate problems concerned with landing a STOL airplane in crosswind conditions. The program included a study of piloting techniques and crosswind limitations during visual STOL type landing operations. The results indicated that the crosswind was more limiting during the ground roll out than during the airborne phases. The pilots estimated that the crosswind limit for commercial STOL type operations with the test aircraft would be approximately 15 to 20 knots. The pilots thought that the crosswind limits for ground operation might be extended by incorporating wing-lift spoilers, improved nose gear steering, and improved engine response. The pilots agreed that a crosswind landing gear would also be beneficial. Author

N77-11002# Lockheed Missiles and Space Co., Huntsville, Ala.
DEVELOPMENT OF PREDICTIVE WAKE VORTEX TRANSPORT MODEL FOR TERMINAL AREA WAKE VORTEX AVOIDANCE Final Report, Feb. - Oct. 1975
M. R. Brashears, A. D. Zalay, L. C. Chou, and K. R. Shrider May 1976 232 p refs
(Contract DOT-TSC-988)
(AD-A029049/4; LMSC-HREC-TR-D496597; FAA-RD-76-94; DOT-TSC-FAA-76-15) Avail: NTIS HC A11/MF A01 CSCL 01/2

The wake vortex transport program was expanded to include viscous effects and the influence of initial roll-up, atmospheric turbulence, and wind shear on the persistence and motion of wake vortices in terminal areas. Analysis of wake characteristics show that changes in the spanwise loading due to flaps increase the initial sink rate, decrease the separation, and initiates the circulation decay process earlier. Buoyancy due to jet exhaust entrainment and ambient stratification retards vortex spreading and increases descent. Atmospheric turbulence and shear promote a more rapid decay reducing the late-time descent and spread rates of vortices. Vortex tilting was related to an interaction involving the wind shear, ground plane, and the vorticity detrainment process. Recognition of the effects of tilting, spanwise loading, vorticity detrainment, burst/sink instabilities, and atmospheric conditions resulted in an analytic wake transport and decay model with increased accuracy and improved predictive capabilities. Author

N77-11003*# Northrop Services, Inc., Huntsville, Ala. Aeromechanics Branch.
PREDICTION OF THE DRAG COEFFICIENT OF A 20-DEGREE CONICAL RIBBON PARACHUTE
Lajpat R. Utreja Sep. 1975 19 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Spacecraft and Rockets in Jan. 1977
(Contract NAS8-21810)
(NASA-CR-150056; TN-230-1523) Avail: NTIS HC A02/MF A01 CSCL 01A

An empirical formula for the steady state drag coefficient of a 20 degree conical ribbon parachute is developed. The derived expression takes into account the effect of suspension line length and geometric porosity within the limits of practical design. Also included are factors which provide drag reduction due to skirt reefing and the wake behind a primary body. The calculated values are in agreement with the available experimental results. Author

N77-11004*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE AND BOUNDARY-LAYER EVALUATION OF A SONIC INLET
James F. Schmidt and Robert S. Ruggeri Washington Nov. 1976 57 p refs
(NASA-TN-D-8340; E-8579) Avail: NTIS HC A04/MF A01 CSCL 01A

Tests were conducted to determine the boundary layer characteristics and aerodynamic performance of a radial vane sonic inlet with a length/diameter ratio of 1 for several vane configurations. The sonic inlet was designed with a slight wavy wall type of diffuser geometry, which permits operation at high inlet Mach numbers (sufficiently high for good noise suppression) without boundary layer flow separation and with good total pressure recovery. A new method for evaluating the turbulent boundary layer was developed to separate the boundary layer from the inviscid core flow, which is characterized by a total pressure variation from hub to tip, and to determine the experimental boundary layer parameters. Author

N77-11005*# Boeing Commercial Airplane Co., Seattle, Wash.
A COMPUTATIONAL SYSTEM FOR AERODYNAMIC DESIGN AND ANALYSIS OF SUPERSONIC AIRCRAFT. PART 2: USER'S MANUAL Final Report, Jan. 1975 - Mar. 1976
W. D. Middleton, J. L. Lundry, and R. G. Coleman Washington NASA Aug. 1976 267 p refs
(Contract NAS1-13732)
(NASA-CR-2716; D6-43798-2) Avail: NTIS HC A12/MF A01 CSCL 01A

An integrated system of computer programs was developed for the design and analysis of supersonic configurations. The system uses linearized theory methods for the calculation of surface pressures and supersonic area rule concepts in combination with linearized theory for calculation of aerodynamic force coefficients. Interactive graphics are optional at the user's request. This user's manual contains a description of the system, an explanation of its usage, the input definition, and example output. Author

N77-11006*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
CALCULATION OF THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF WING-FLAP CONFIGURATIONS WITH EXTERNALLY BLOWN FLAPS Final Report
Michael R. Mendenhall, Selden B. Spangler, Jack N. Nielsen, and Frederick K. Goodwin Washington NASA Sep. 1976 143 p refs
(Contract NAS1-13158)
(NASA-CR-2705) Avail: NTIS HC A07/MF A01 CSCL 01A

A theoretical investigation was carried out to extend and improve an existing method for predicting the longitudinal characteristics of wing flap configurations with externally blown flaps (EBF). Two potential flow models were incorporated into the prediction method: a wing and flap lifting-surface model and a turbofan engine wake model. The wing-flap model uses a vortex-lattice approach to represent the wing and flaps. The jet wake model consists of a series of closely spaced vortex rings normal to a centerline which may have vertical and lateral curvature to conform to the local flow field beneath the wing and flaps. Comparisons of measured and predicted pressure distributions, span load distributions on each lifting surface, and total lift and pitching moment coefficients on swept and unswept EBF configurations are included. A wide range of thrust coefficients and flap deflection angles is considered at angles of attack up to the onset of stall. Results indicate that overall lift and pitching-moment coefficients are predicted reasonably well over the entire range. The predicted detailed load distributions are qualitatively correct and show the peaked loads at the jet impingement points, but the widths and heights of the load peaks are not consistently predicted. Author

N77-11007*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TWO-DIMENSIONAL COLD-AIR CASCADE STUDY OF A FILM-COOLED TURBINE STATOR BLADE. 3: EFFECT OF HOLE SIZE ON SINGLE-ROW AND MULTIROW EJECTION

Herman W. Prust, Jr. and Thomas P. Moffitt Washington Oct. 1976 33 p refs

(NASA-TM-X-3442; E-8720) Avail: NTIS HC A03/MF A01 CSCL 20D

The effect of coolant discharge on the aerodynamic performance of a film cooled turbine stator blade was determined. The blade had the same number, location, and injection angle of coolant holes, but the coolant hole diameters were one half that of a previously investigated blade. Otherwise the blades were the same. Tests with discharge from individual coolant rows and multiple coolant rows, including full film discharge are studied. The results of the blade with smaller holes are reported and compared with the blades with larger holes. Author

N77-11008*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF 1.15-PRESSURE-RATIO FAN STAGE AT SEVERAL ROTOR BLADE SETTING ANGLES WITH REVERSE FLOW

George Kovich and Royce D. Moore Washington Nov. 1976 91 p refs

(NASA-TM-X-3451; E-8571) Avail: NTIS HC A05/MF A01 CSCL 21E

A 51 cm diameter low pressure ratio fan stage was tested in reverse flow. Survey flow data were taken over the range of rotative speed from 50 percent to 100 percent design speed at several rotor blade setting angles through both flat and feather pitch. Normal flow design values of pressure ratio and weight flow were 1.15 and 29.9 kg/sec with a rotor tip speed of 243.8 m/sec. The maximum thrust in reverse flow was 52.5 percent of design thrust in normal flow. Author

N77-11009*# Transemantics, Inc., Washington, D.C.

SECONDARY FLOW IN AXISYMMETRIC COMPRESSORS

R. Flot, K. Papiliou, and J. Mathieu NASA Jun. 1976 87 p Transl. into ENGLISH from Ecoulements Secondaires dans les Compresseurs Axiaux, Aeron. et Astronautique de France (Paris) report AAAF-NT-75-7, 1975, 88 p

(Contract NASw-2792)

(NASA-TT-F-15497) Avail: NTIS HC A05/MF A01 CSCL 01A

The results of three experiments aimed at determining secondary flows in compressor walls by simulation of the flow through impellers are presented. An analysis and comparison with existing theories were performed. The longitudinal velocity profile is described by bidimensional flow while the transversal velocity profile trend can be evaluated only by present theories. The wall flow seems to follow three dimensional theory results. Author

N77-11010# National Aerospace Lab., Amsterdam (Netherlands). Scientific Services Div.

AN ALGOL PROGRAM FOR THE CALCULATION OF INCOMPRESSIBLE THREE DIMENSIONAL TURBULENT BOUNDARY LAYERS

J. P. F. Lindhout 5 Feb. 1975 70 p refs Sponsored by Directorate of Mater. Air., RNLAF

(NLR-TR-74159-U) Avail: NTIS HC A04/MF A01

An ALGOL program developed for the calculation of flow quantities in a 3-D turbulent boundary layer is described. The program is limited to incompressible flow over developable surfaces with known pressure distribution. The method can be used for the accurate calculation of the skin friction and other quantities of boundary layers on winglike aircraft components. It can also be used as a reference for the empirical methods that are used to estimate the skin friction drag in aircraft performance evaluation studies. The method is based on that of turbulent energy. This turbulence model can be expressed in two partial differential equations containing the transport, diffusion, dissipation, and growth of turbulence energy. The numerical procedures for solving the equations inside the curved boundaries of the computational region are described. The introduction of a logarithmic difference factor is also discussed. ESA

N77-11011# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

CALCULATION OF THE FLOW AROUND A SWEPT WING, TAKING INTO ACCOUNT THE EFFECT OF THE THREE-DIMENSIONAL BOUNDARY LAYER. PART 1: WING WITH TURBULENT BOUNDARY LAYER

W. J. Piers, G. J. Schipholt, and B. VandenBerg 27 May 1975 44 p refs

(Contract NIVR-1737)

(NLR-TR-75076-U) Avail: NTIS HC A03/MF A01

The attached flow around swept wing was calculated with allowance for the effects of boundary layer and wake. The outer potential flow was computed with an adapted version of the NLR panel method. The displacement effect of the boundary layer and the wake was taken into account by the outflow concept. For the calculation of the three-dimensional turbulent boundary layer the method of Wesseling and Lindhout was used. The boundary layer calculations were based on measured pressure distributions, while, for the wake, a crude estimation was made. It is concluded that the calculated potential flow, with allowance for viscous effects, compares well with experimental results in terms of pressure and lift distribution. With regard to the computing time the potential flow program was about eight times faster than the boundary layer program. Author (ESA)

N77-11012# Institut Franco-Allemand de Recherches, St. Louis (France).

A FORTRAN PROGRAM FOR THE COMPUTATION OF TWO-DIMENSIONAL OR AXISYMMETRIC NOZZLES [UN PROGRAMME FORTRAN POUR LE CALCUL D'UNE TUYERE SUPERSONIQUE PLANE OU DE REVOLUTION]

B. C. Jaeggy 4 Apr. 1975 58 p refs In FRENCH

(ISL-R-110/75) Avail: NTIS HC A04/MF A01

This program, minimizing operator interventions, provides the necessary codes for the manufacturing of the nozzle using the following data: ratio of heat mass of gas, Mach number required at the nozzle exit, ratio of throat curvature radius to height or to throat radius, and height or diameter of exit section. The program and numerical method used (method of characteristics for the supersonic zone, development of velocity potential for the initial conditions) are described. The principal characteristics of a nozzle applied to an installation for studying the supersonic free jets are given. ESA

N77-11013# Hydronautics, Inc., Laurel, Md.

HIGH SPEED COMPUTER STUDIES OF VORTEX MOTIONS IN RELATION TO AIRCRAFT WAKE TURBULENCE Final Report

Clinton E. Brown and Peter VanDyke Jan. 1976 42 p refs

(Contract F44620-71-C-0080; AF Proj 9781)

(AD-A024290; TR-7115-4; AFOSR-76-0481TR) Avail: NTIS HC A03/MF A01 CSCL 01/1

Computations are presented and compared with experimental data from other sources for basic and advanced problems in

aircraft - wake vortex interactions. Results are presented for coalescence of corotation and counterrotating vortex groups and finally a complete high speed computer method is developed for simulating the roll reaction of an aircraft to the wake produced by a large aircraft with flaps deployed. Suggestions for improved experimental approaches are also appended. Author (GRA)

N77-11014# Air Force Academy, Colo. Frank J. Seiler Research Lab.

THE MEASUREMENT OF SPATIAL VORTICITY DISTRIBUTIONS USING HOT-WIRE ANEMOMETRY TECHNIQUES Interim Report

Michael S. Francis, Donald A. Kennedy, and Gerald A. Butler Apr. 1976 29 p refs
(AF Proj. 7905)
(AD-A024161; FJSRL-TR-76-0007) Avail: NTIS HC A03/MF A01 CSCL 20/4

A simple method for measuring spatial vorticity content employing hot-wire anemometry techniques is proposed for flows where the primary convective velocity is locally greater than the mean crossflow components. Errors associated with the technique are computed exactly and in simple linearized forms to illustrate its validity in a wide range of flows. Applications of the technique to the problems of an isolated trailing vortex and to a nominally unsteady flow field are discussed as examples. Author (GRA)

N77-11015# ARO, Inc., Arnold Air Force Station, Tenn.

THE AFFDL-NIELSEN FLOW-FIELD STUDY Final Report, 25 Jun. - 10 Jul. 1975

William T. Strike, Terry R. Penney, and John H. Porter AEDC Apr. 1976 90 p refs
(AF Proj. 8219; ARO Proj. V41A-B4A)
(AD-A023755; ARO-VKF-TR-75-164; AEDC-TR-76-18) Avail: NTIS HC A05/MF A01 CSCL 20/4

This test was conducted in support of a program to develop a generalized analytical method for predicting the separation characteristics of stores from a high-speed aircraft (parent body). The tests were conducted in the von Karman Gas Dynamics Facility (VKF), Tunnel A, at nominal Mach numbers of 1.5, 1.76, 2.0, and 2.5 at a nominal free-stream Reynolds number of 4 x 10 to 6th power per foot. The test program involved three phases, namely flow-field surveys using a cone probe rake to determine local flow-field angles and velocity, pressure distributions on the store as it separated from a parent body, and six-component force and moment data on the store. The tests were conducted at angles of attack of zero and five degrees. This document contains a detailed description of the calibration procedure for the 20 deg half-angle cone probes and the method used to evaluate the local flow-field properties from the cone probe surface pressure and pitot pressure measurements. Also included is a comparison of integrated pressure data with the force and moment data obtained on the storebody by a balance. Author (GRA)

N77-11016# Ballistic Research Labs., Aberdeen Proving Ground, Md.

AN IMPROVED PROJECTILE BOATTAIL, PART 2 Final Report

Anders S. Platou and George I. T. Nielsen Mar. 1976 160 p refs
(DA Proj. 1T1-61102-A-33D)
(AD-A024073; BRL-1866-Pt-2) Avail: NTIS HC A08/MF A01 CSCL 19/1

A series of projectile boattails have shown improved aerodynamic performance over the standard conical boattail. These boattails have equal or lower drag and an improved gyroscopic stability. Their Magnus and damping characteristics appear to be satisfactory so that the projectile should be dynamically stable. Also, these boattails increase the projectile wheel base considerably, thereby decreasing the balloting in the gun tube. The improved aerodynamic performance could lead to longer ranges, larger payloads, or lower spin rates for future projectiles. GRA

N77-11017# Lockheed-Georgia Co., Marietta.

VORTEX/JET/WING VISCOUS INTERACTION THEORY AND ANALYSIS Technical Report, 1 Mar. 1975 - 29 Feb. 1976

R. M. Scruggs and C. J. Dixon 27 Feb. 1976 75 p refs
(Contract N00014-74-C-0151; NR Proj. 215-233)
(AD-A025290; LG76ER0007; ONR-CR215-233-2) Avail: NTIS HC A04/MF A01 CSCL 20/4

A computational fluid mechanical model has been developed for analyzing the loads and flow mechanism due to vortex/wing/jet interaction. Examples are leading edge vortices formed on highly swept delta wings or moderately swept wings with vortex control by jets or passive control such as strakes. The computational model is applicable to a wide class of viscous flows but is particularly suitable for calculating vortex-type flows near no-slip or solid boundaries. The model is based on reducing the full Navier-Stokes equations to parabolic form with respect to one of the three space coordinates. The method is particularly attractive because of the economy of computing time. Minutes rather than hours bring the solution of the Navier-Stokes equations into the engineering realm. Further development of the model is required, but its present state is quite useful for evaluating certain flow mechanisms. Examples of computations for various vortex/wing/jet interactions are presented in the report. Experimental pressure laser velocimeter, and flow visualization data are presented for an unswept wing with leading edge vortex control by spanwise blowing. These data are used to analyze the formation and strength of the leading edge vortex and as examples of typical input/output data for the computational model.
Author (GRA)

N77-11018# Ballistic Research Labs., Aberdeen Proving Ground, Md.

SOME SUPERSONIC WIND TUNNEL NOZZLE BOUNDARY LAYER CHARACTERISTICS Final Report

James E. Danberg Apr. 1976 29 p refs
(DA Proj. 1T1-61102-A-33H)
(AD-A024980; BRL-MR-2618) Avail: NTIS HC A03/MF A01 CSCL 20/4

Sidewall and nozzles wall boundary layer profile parameters have been determined by a least-squares fit of a 'law of the Wall' -- 'law of the wake' turbulent boundary layer equation to a number of experimental observations including some recent data from the BRL Supersonic Wind Tunnel No. 1. The parameters include: Velocity scale, thickness, wake and wall region parameters. Quantitative comparisons have been made between boundary layer measurements in the BRL tunnel and other facilities. Variation of Mach number is found to affect the sidewall wake region considerably more than it affects the nozzle wall boundary layer and this is believed to be related to the differences in the upstream history of the two layers. Author (GRA)

N77-11224*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LASER VELOCIMETRY APPLIED TO TRANSONIC AND SUPERSONIC AERODYNAMICS

D. A. Johnson, W. D. Bachalo, and D. Moddaress *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 12 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11236# Princeton Univ., N.J. Gas Dynamics Lab.

THE ELECTRON BEAM FLUORESCENCE TECHNIQUE APPLIED TO HYPERSONIC TURBULENT FLOWS

Jerome A. Smith and James F. Driscoll (Michigan Univ.) *In* AGARD Appl. of Non-Instrusive Instr. in Fluid Flow Res. May 1976 10 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11245# Politecnico di Milano (Italy).

FLOW FIELD IN THE WAKE OF A BLUNT BODY BY LASER DOPPLER ANEMOMETRY

F. Cignoli, A. Coghe, U. Ghezzi, and S. Pasini *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N77-11019*# Transemantics, Inc., Washington, D.C.
TOWARD NEW HEIGHTS
B. P. Bugayev NASA Oct. 1976 82 p refs Transl. into ENGLISH of the mono. "K Novym Vystam (Novoye v Zhizni, Nauke, Tekhnike. Seriya Transport, no. 3)" Moscow, Znaniye Press, 1976 p 1-64
(Contract NASw-2792)
(NASA-TT-F-17248) Avail: NTIS HC A05/MF A01 CSCL 01B

Aeroflot is not only the daily transport of hundreds of thousands of passengers, but also the delivery of equipment, machinery, parts, and other cargoes to construction sites of the energy and industrial giants, flights with geologists in search of petroleum, gas and other natural resources, ice reconnaissance, aid to fishermen on the open sea, emergency flights to patients with a physician aboard, the protection of forests against fires and much else. The results are presented of accomplishing the tasks of the Ninth Five-year Plan and how Civil Aviation will develop in the future. Author

N77-11020# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
THE ESTABLISHMENT OF SAFE SEPARATIONS BETWEEN AIRCRAFT IN FLIGHT
A. Pool 1 Dec. 1975 12 p Presented at the 28th Intern. Air Safety Seminar, Amsterdam, 3-5 Nov. 1975
(NLR-MP-75041-U) Avail: NTIS HC A02/MF A01

The history of the use of models and statistical data for the assessment of separation standards is reviewed. This work was mainly done by the ICAO Vertical Separation Panel, the North Atlantic Systems Planning Group, and the ICAO Panel for the Review of the General Concept of Separation. After a brief description of the model and of the 'target level of safety', plans for future work are indicated. Author (ESA)

N77-11021# New York City Transporation Administation, N.Y.
THE OPERATION OF HOVERCRAFT IN NEW YORK CITY METROPOLITAN AREA. VOLUME 2: ECONOMIC FEASIBILITY
Feb. 1975 91 p refs
(DOT-PS-40346)
(PB-251235/8; DOT-TPI-76-1-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 13B

The feasibility of using air cushion vehicles (ACV) on the inland waterways of New York City was studied. Revived use of the waterways employing the technology in high speed marine transportation systems could revitalize the waterfront while relieving some congestion on land modes of transportation. The value of the city's inland waterways related to a balanced, multimodal, mass transportation system is assessed. Commuter corridors, and other routes where water transportation offers an alternative, or complementary, service to existing land transportation are identified. A consumer survey was conducted to study human attitudes toward the use of water transportation in lieu of existing land systems. For Vol. 1, see N76-31209. GRA

N77-11022# Naval Surface Weapons Center, White Oak, Md.
AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS. CHARACTERISTICS OF KINEMATIC JET FUEL FIRES CASCADING AND ROD FUEL GEOMETRIES Final Report, Dec. 1974 - Dec. 1975
R. S. Alger, F. I. Laughridge, L. L. Wiltshire, R. G. McKee (Stanford Res. Inst., Menlo Park, Calif.), W. H. Johnson (Stanford Res. Inst., Menlo Park, Calif.), and N. S. Alvares (Stanford Res. Inst., Menlo Park, Calif.) Wright-Patterson AFB, Ohio DON Aircraft Ground Fire Suppression and Rescue Office Mar. 1976 83 p refs Sponsored by DOD Aircraft Ground Fire Suppression and Rescue Office Prepared jointly by Stanford Res. Inst., Menlo Park, Calif.
(AD-A024447; DOD-AGFSRS-76-3) Avail: NTIS HC A05/MF A01 CSCL 01/2

Based on a survey of kinematic fuel fires in aircraft accidents, two types, i.e., cascade and rod fuel flows, were selected to theoretical and experimental examination. The twofold objectives was (1) relate fire characteristics such as burning rate, radiation field, and flame size to the fuel parameters, the flowing conditions, and the environment, and (2) determine the parameters and their degree of control required to achieve reproducible fires suitable for testing extinguishing agents, equipment, and techniques. Theoretical models based on steady, laminar, one-dimensional flow were developed. GRA

N77-11023# RAND Corp., Santa Monica, Calif.
A SECOND LOOK AT RELATIONSHIPS FOR ESTIMATING PEACETIME AIRCRAFT ATTRITION Interim Report
William E. Mooz Feb. 1976 65 p refs
(Contract F44620-73-C-0011)
(AD-A023681; R-1840-PR) Avail: NTIS HC A04/MF A01 CSCL 01/3

The attrition experience of individual aircraft systems is found to change over the flying life of the system in such a way as to continually lower the attrition rate. This process can be represented mathematically, and the resulting model used to project future losses for the system. A study was made to evaluate the results of an earlier Rand study of peacetime aircraft attrition (RM-4840-PR, August 1966) in light of 12 years of additional flying hour and attrition data supplied by the Air Force Inspection and Safety Center. The earlier study resulted in sufficient understanding of the attrition process to develop estimating methodologies that were adopted by the Air Force in official publications and that are still in use. The conceptual bases for the findings of the first study are discussed, and in conjunction with statistical parameters and an examination of some typical projections, the utility of the method is evaluated. Author (GRA)

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N77-11024# Westinghouse Defense and Electronic Systems Center, Baltimore, Md. Aerospace and Electronic Systems Div.
FINAL APPROACH PERFORMANCE MONITOR Final Report
I. T. Basil Jul. 1976 189 p
(Contract DOT-FA72WA-2837)
(AD-A028513/0; FAA-RD-76-117; Rept-75-0280A) Avail: NTIS HC A09/MF A01 CSCL 17/7

The objectives, the system design goals, the hardware developed, and the laboratory test results of an instrument landing system (ILS) performance monitor are stipulated. This new measuring system makes angular measurements of the angular deviation from the glidepath of an aircraft on a final approach. Measurements are made once every airport surveillance radar (ASR) scan. The signal used for this measurement is the aircraft's transponder reply to the ASR interrogation. A fixed monopulse monitoring antenna measures the angular position of the aircraft relative to the antenna boresight. Since the antenna is boresighted along the glidepath, computations can determine the deviation of the aircraft from the glideslope. The technique is very precise in measuring angular deviation from antenna boresight; its range measuring accuracy is limited by the inherent jitter in the transponder reply. Author

N77-11025# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TEST AND EVALUATION OF THE BEACON PROCESSING SUBSYSTEM OF THE AUTOMATED RADAR TERMINAL

SYSTEMS (ARTS III) ALL-DIGITAL TRACKING LEVEL SYSTEM Final Report, Oct. 1974 - Jun. 1975
Martin Holtz and Mark Schoenthal Jul. 1976 281 p
(AD-A028514/8; FAA-RD-76-98; FAA-NA-75-46) Avail: NTIS HC A13/MF A01 CSCL 17/7

The test and evaluation are reported which were conducted to determine the performance of the beacon processing subsystem (BPS) of the Automated Radar Terminal System (ARTS-III) all-digital tracking level system. A test bed was established to perform an evaluation of the level-one ARTS III system in fiscal year 1973. This included development of statistical reduction programs to provide summary data defining system performance. The test bed and reduction program interface were modified to accommodate the improved beacon data acquisition subsystem (BDAS). Technical tests were conducted using special test equipment to determine the characteristics of the improved BDAS and improved software. These tests included wide pulse detection, garble detection, code validation, processor loading, probability of detection, false alarm rates, and defruiter performance. Actual target data within the National Aviation Facilities Experimental Center (NAFEC) environment were processed to determine the effect of various system configurations. It was concluded that system performance of the BPS is superior to that achieved with the level-one ARTS III system. Incorporation of a minimum-hit threshold of three enhanced performance of the system for undefruited inputs. Overall performance was significantly degraded for system configurations employing a defruiter function. However, processor loading was far less for defruited replies. Author

N77-11026# DARCOM Intern Training Center, Texarkana, Tex.
FEASIBILITY STUDY OF PERFORMING SYSTEM CALIBRATION IN AN OPERATE MODE Final Report
Robert Joseph Gorak Apr. 1976 95 p refs
(AD-A024744; DARCOM-ITC-02-08-76-006) Avail: NTIS HC A05/MF A01 CSCL 17/7

The availability of a system can be upgraded if the usual downtime allocated for performing calibration tasks is reduced or eliminated. The objective of this paper is to study the feasibility of performing the calibration of system parameters while the system is in an operate mode. To this end, a calibration technique exhibiting this feature was developed and studied for a marine inertial navigation system. The errors introduced by the calibration technique were examined, and problematic areas were outlined. Although the report is directed specifically towards the calibration of certain parameters of a particular system, the ideas and concepts presented in the development of the report's calibration technique should be applicable to other systems for the elimination of all or some of their calibration downtime. The formulation of a similar type of calibration procedure is especially desirable for systems whose unavailability at a time of critical need could result in a catastrophic loss of men, material and tactical advantage. Author (GRA)

N77-11027# Optelecom, Inc., Gaithersburg, Md.
DEVELOPMENT OF AN OPTICAL FIBER VIDEO DATA LINK Final Report, Dec. 1973 - Feb. 1975
William H. Culver and Edmund D. Ludwig Feb. 1975 62 p refs
(Contract DAAH01-74-C-0417)
(AD-A025220) Avail: NTIS HC A04/MF A01 CSCL 17/7

Investigations were conducted to develop techniques for paying out optical fibers wound on non-rotating spools. The fibers were payed out off the end of the spool in a manner similar to that employed by a spinning reel or wire guided missile. Payout velocities in excess of 300 feet per second were demonstrated. The upper limit payout velocity is estimated to be at least 600 feet per second. This technique should make possible TV guidance of a missile by transmitting optical signals over the fiber to a remote operator out of line of sight of the missile. GRA

N77-11028# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
FLIGHT TEST DEMONSTRATION OF SELECTED CURVED-SEGMENTED APPROACH PATHS BASED ON MICROWAVE LANDING SYSTEM GUIDANCE Final Report, Jul. - Oct. 1975
J. Wyatt and D. Eastman Jan. 1976 140 p
(AD-A025501; AFFDL-TR-76-43) Avail: NTIS HC A07/MF A01 CSCL 17/7

The report contains aircraft and pilot performance parameters, such as aircraft tracking errors, response characteristics, and pilot acceptance for eight representative Microwave Landing System Profiles. The USAF T-39 aircraft was capable of flying fully coupled and automatic curved and segmented approaches using MLS position information. The nature of the testing was designed to demonstrate an inherent MLS capability and trend rather than to provide a great amount of statistical data on the feasibility or acceptability of certain curved or segmented approaches. It is concluded from the flight test data gathered at NAFEC, Atlantic City, N.J. that the selected Microwave Landing System can be used to generate sufficient and accurate airborne data to safely perform curved and segmented approaches to landing. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

N77-11029*# Transemantics, Inc., Washington, D.C.
CALCULATION OF MULTI-CONTOUR THIN-WALLED STRUCTURES BY THE METHOD OF SECTIONS
V. G. Shatayev NASA Nov. 1976 15 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), no. 2, Feb. 1976 p 117-123
(Contract NASw-2792)
(NASA-TT-F-17284) Avail: NTIS HC A02/MF A01 CSCL 01C

In calculating thin-walled airframe structures of the type used in the wings and tails of aircraft, the hypothesis of the invariability of the shape of the contour of the cross sections during deformation is widespread. Many theoretical and experimental studies have shown that it applies in the study of the majority of problems of strength of wing and tail assemblies. The method of final sums is used in this article to obtain the numerical solution for a cantilevered thin-walled beam. Matrix formulation of basic relationships, equations for numerical solution of a cantilevered stringer, and methods of sections are discussed. Author

N77-11030*# Aerospace Systems, Inc., Burlington, Mass.
DISPLAY/CONTROL REQUIREMENTS FOR VTOL AIRCRAFT Interim Technical Report
William C. Hoffman, Renwick E. Curry (MIT, Cambridge), David L. Kleinman (Connecticut Univ., Storrs), Walter M. Hollister (MIT, Cambridge), and Laurence R. Young (MIT, Cambridge) Aug. 1975 273 p refs
(Contract NAS1-13653)
(NASA-CR-145026; ASI-TR-75-26) Avail: NTIS HC A12/MF A01 CSCL 01C

Quantative metrics were determined for system control performance, workload for control, monitoring performance, and workload for monitoring. Pilot tasks were allocated for navigation and guidance of automated commercial V/STOL aircraft in all weather conditions using an optimal control model of the human operator to determine display elements and design. A.H.

N77-11031*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY SIZING AND PERFORMANCE EVALUATION OF SUPERSONIC CRUISE AIRCRAFT
D. E. Fetterman, Jr. Sep. 1976 80 p refs
(NASA-TM-X-73936) Avail: NTIS HC A05/MF A01 CSCL 01C

The basic processes of a method that performs sizing operations on a baseline aircraft and determines their subsequent effects on aerodynamics, propulsion, weights, and mission performance are described. The input requirements of the associated computer program are defined and its output listings explained. Results obtained by applying the method to an advanced supersonic technology concept are discussed. These results include

the effects of wing loading, thrust-to-weight ratio, and technology improvements on range performance, and possible gains in both range and payload capability that become available through growth versions of the baseline aircraft. The results from an in depth contractual study that confirm the range gain predicted for a particular wing loading, thrust-to-weight ratio combination are also included. Author

N77-11032*# Lockheed-Georgia Co., Marietta.
PROGRAM FOR ESTABLISHING LONG-TIME FLIGHT SERVICE PERFORMANCE OF COMPOSITE MATERIALS IN THE CENTER WING STRUCTURE OF C-130 AIRCRAFT. PHASE 4: GROUND/FLIGHT ACCEPTANCE TESTS
W. E. Harvill and J. A. Kizer Sep. 1976 153 p refs
(Contract NAS1-11100)
(NASA-CR-145043; LG76ER0095) Avail: NTIS HC A08/MF A01 CSCL 01C

The advantageous structural uses of advanced filamentary composites are demonstrated by design, fabrication, and test of three boron-epoxy reinforced C-130 center wing boxes. The advanced development work necessary to support detailed design of a composite reinforced C-130 center wing box was conducted. Activities included the development of a basis for structural design, selection and verification of materials and processes, manufacturing and tooling development, and fabrication and test of full-scale portions of the center wing box. Detailed design drawings, and necessary analytical structural substantiation including static strength, fatigue endurance, flutter, and weight analyses are considered. Some additional component testing was conducted to verify the design for panel buckling, and to evaluate specific local design areas. Development of the cool tool restraint concept was completed, and bonding capabilities were evaluated using full-length skin panel and stringer specimens. Author

N77-11033*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LANDING PRACTICES OF GENERAL AVIATION PILOTS IN SINGLE-ENGINE LIGHT AIRPLANES
Maxwell W. Goode, Thomas C. OBryan, Kenneth R. Yenni, Robert L. Cannaday, and Marna H. Mayo Washington Oct. 1976 50 p refs Technical film supplement L-1208 is available on loan from Langley Research Center, Attn: Photographic Branch, mail stop 425, Hampton, Va. 23665
(NASA-TN-D-8283; L-10878) Avail: NTIS HC A03/MF A01 CSCL 05H

The methods and techniques used by a group of general aviation pilots during the landing phase of light airplane operations are documented. The results of 616 landings made by 22 pilots in 2 modern, four-place, single-engine, flight airplanes (one having a low wing and the other, a high wing) are presented. The landings were made on both a long runway (1524 m (5000 ft)) and a short runway (762 m (2500 ft)); both runways were considered typical of those used in general aviation. The results generally show that most of the approaches were fast with considerable floating during the flares and with touchdowns that were relatively flat or nose-low. Author

N77-11034*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INVESTIGATION OF THE EFFECTS OF NONHOMOGENEOUS (OR NONSTATIONARY) BEHAVIOR ON THE SPECTRA OF ATMOSPHERIC TURBULENCE Final Report
William D. Mark and Raymond W. Fischer Washington NASA Oct. 1976 115 p refs Sponsored in part by AFFDL
(Contract NAS1-13709)
(NASA-CR-2745; Rept-3233) Avail: NTIS HC A06/MF A01 CSCL 04A

A new series expansion of the instantaneous power spectrum is used that has for its first term the usual quasi-stationary spectrum approximation. The minimum duration of a burst of turbulence and the minimum rise time of an abrupt onset of turbulence that will not give rise to changes in the spectrum due to the nonstationary behavior are determined. A general criterion for envelope behavior that will not give rise to changes in the spectrum is also determined. Spectra computed from recorded turbulence time histories are shown to be consistent with the theoretical predictions. Author

N77-11035# Rockwell International Corp., Columbus, Ohio. Missile Systems Div.
CONCEPTUAL DESIGNS FOR A MODULAR REMOTELY PILOTED VEHICLE Final Report, 2 Dec. 1974 - 26 Nov. 1975
Francis L. Goebel, Kirsey O. Smith, and Frederick W. Hessman Jan. 1976 279 p refs
(Contract F33615-75-C-3036; AF Proj. 1989)
(AD-A023844; C75-1443/034C; AFFDL-TR-75-162) Avail: NTIS HC A13/MF A01 CSCL 01/3

The application of the modular design approach to remotely piloted vehicles is described. It is shown, that by modular exchange of structural and equipment components, a basic vehicle can be configured to perform low level recce and strike, medium altitude EW, high altitude recce, and tactical air-to-air missions. Two basic vehicle configuration design concepts which differ primarily in engine installation arrangement (nacelle versus internal) are presented. The design approach, using the nacelle-mounted engine, is shown to be superior and to provide the best basis for a technology evaluator or demonstrator. GRA

N77-11036# Douglas Aircraft Co., Inc., Long Beach, Calif.
DEVELOPMENT OF A GRAPHITE HORIZONTAL STABILIZER Final Report, 3 Nov. 1969 - 31 Aug. 1975
George M. Lehman, M. Ashizawa, M. J. Gallippi, A. V. Hawley, and C. A. VanPappelendam Mar. 1976 85 p
(Contract N00156-70-C-1321; WF41422206)
(AD-A023767; MDC-J6902; NADC-76078-30) Avail: NTIS HC A05/MF A01 CSCL 01/3

A summary of the design synthesis, structural development testing, tooling, manufacturing, and ground testing of an advanced composite horizontal stabilizer for the A-4 Skyhawk is presented. The stabilizer utilized Narmco 5206 graphite-epoxy as the primary load-bearing structural material (58.5 percent by weight). The most significant problem encountered was the development of structurally efficient joints. In ground tests, the graphite stabilizer successfully sustained design ultimate loads and subsequently sustained two lifetimes of fatigue spectrum loads. A positive margin-of-safety of 12 percent was indicated in a final ultimate-strength test after completion of the fatigue test. A flutter analysis based on the natural modes and frequencies of the graphite stabilizer indicated an improvement in empennage flutter speed. A weight reduction of 26.2 percent was achieved in comparison to the existing metal stabilizer. GRA

N77-11037# ARO, Inc., Arnold Air Force Station, Tenn.
A WIND TUNNEL CAPTIVE AIRCRAFT TESTING TECHNIQUE Final Report, 1 Jul. 1974 - 30 Jun. 1975
R. W. Butler AEDC Apr. 1976 37 p refs
(ARO Proj. P32A-33A; ARO Proj. P41T-78A)
(AD-A023690; ARO-PWT-TR-75-80; AEDC-TR-76-22) Avail: NTIS HC A03/MF A01 CSCL 01/3

A captive aircraft testing technique has been developed for use in the 16-ft wind tunnels at the Arnold Engineering Development Center (AEDC). With the captive system, an aircraft motion study may be conducted in the wind tunnel with the tunnel acting as an analog forcing function. The large static aerodynamic data matrix normally required for a motion study has been alleviated. The system validity is established by a comparison of F-15 aircraft motion generated in the wind tunnel with flight motion of a NASA 3/8-scale F-15 Remotely Piloted Vehicle (RPV). Good agreement between the longitudinal and lateral/directional motions of the model was achieved in the absence of RPV unsteady aerodynamics (wing buffet). The captive technique ability to efficiently define changes in aircraft flight characteristics resulting from different external store configurations is demonstrated. Author (GRA)

N77-11038# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
CATAPULT LAUNCH FATIGUE INVESTIGATION OF THE MODEL S-2 E AIRPLANE Final Report
H. D. Lystad 31 Dec. 1975 58 p refs
(AD-A024071; NADC-75368-30) Avail: NTIS HC A04/MF A01 CSCL 01/3

A laboratory fatigue investigation was performed on an S-2 E fuselage with reinforced catapult keel beam and holdback carry through structure to determine if it could sustain the loads

associated with 3,000 catapult launches. The bulkhead at fuselage station 206 failed after 5,690 test cycles of the catapult start of run condition. Using a test scatter factor of 2, this is equivalent to 2,845 service catapult launches. The test article experienced 419 service catapult launches prior to reinforcement, which when added to the test results provides for a service catapult launch life in excess of 3,000 launches. The holdback release condition test was discontinued after 10,000 test cycles, with no failures. Again, using a test scatter factor of 2, this is equivalent to 5,000 service catapult launches. Author (GRA)

N77-11039# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

ARMY PRELIMINARY EVALUATION YOH-58A HELICOPTER WITH A FLAT-PLATE CANOPY Final Report

James R. Arnold and Gary L. Skinner Dec. 1975 45 p refs
(AD-A024501; USAAEFA-75-20) Avail: NTIS HC A03/MF A01 CSCL 01/3

A limited evaluation of the performance and handling qualities of the OH-58A helicopter was conducted to determine the effects of a four-plane flat-plate canopy installation. Testing was conducted at the Bell Helicopter Company flight test facility at Arlington, Texas, from 25 October through 4 November 1975. Personnel from the United States Army Aviation Engineering Flight Activity conducted 11 test flights for a total of 6.5 productive test flight hours. The evaluation revealed a loss in airspeed of 2 and 6 knots at the airspeed for maximum continuous power and a loss in range of 8 and 23 nautical miles at the cruise airspeed (forward and aft center-of-gravity configurations, respectively). The noticeable changes in the handling qualities were a slight increase in the nose-down pitching rate following a sudden loss of power (more pronounced for the forward center-of-gravity configuration) and a slight increase in the dihedral effect of the helicopter. The flat-plate canopy installation resulted in a slight reduction in the field of view, but visibility was improved due to the optical clarity of the flat-plate. The installation of glare shields between the chin bubble and canopy significantly reduced the canopy reflections during both day and night tests. One shortcoming was noted during this evaluation but cannot be attributed to the flat-plate canopy installation. Author (GRA)

N77-11040# Naval Air Development Center, Warminster, Pa. Vehicle Technology Dept.

FATIGUE INVESTIGATION OF THE E-2B/C NOSE LANDING GEAR Final Report

H. D. Lystad 31 Dec. 1975 65 p refs
(AD-A024072; NADC-75369-30) Avail: NTIS HC A04/MF A01 CSCL 01/3

A laboratory fatigue investigation was performed on an E-2B and an E-2C nose landing gear to determine whether the authorized limit of 650 catapult launches could be extended. The starboard holdback lug of the E-2B nose landing gear, with modified drag brace attachment lugs, failed after the application of 3,336 test cycles. Using a test scatter factor of two, this is equivalent to 1,668 service catapult launches. The outer cylinder of the E-2C shock strut assembly cracked under the packing nut after completion of 7,430 test cycles. Again, using a test scatter factor of two, this is equivalent to 3,715 service catapult launches. Author (GRA)

N77-11041# Bell Helicopter Co., Fort Worth, Tex.

HELICOPTER RELIABILITY GROWTH EVALUATION Final Report

G. S. Conway Apr. 1976 170 p refs
(Contract DAAJ02-73-C-0097; DA Proj. 1F1-63204-DB-38)
(AD-A025265; USAAMRDL-TR-75-53) Avail: NTIS HC A08/MF A01 CSCL 01/3

This report presents the results and data resulting from a research evaluation made of the reliability growth characteristics of the development and early production of UH-1D and AH-1G helicopters. The major subjects covered by the technique and backed by research are: off-board MTBF, reliability (MTBF) growth versus test time, and reliability growth versus calendar time. A tentative technique for predicting helicopter reliability growth applicable to reliability program planning and management is also presented based on the results of the research. An example of the technique procedures applied to a hypothetical helicopter is also presented. Author (GRA)

N77-11042# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

ANALOG COMPUTATION ASSESSMENT OF THE RISK OF STRUCTURAL FAILURE DUE TO CRACK GROWTH UNDER RANDOM LOADING Final Report, Feb. 1974 - May 1975

Oscar Orringer, Richard F. Harris, and John F. McCarthy, Jr. Oct. 1975 98 p refs
(Contract F33615-74-C-3046; AF Proj. 1929)
(AD-A025266; ASRL-TR-179-1; AFFDL-TR-75-123) Avail: NTIS HC A05/MF A01 CSCL 01/3

Risks of fracture were computed from a Monte Carlo simulation of the Paris equation for crack growth rate. The simulation covered a total number of load events approximately equivalent to the estimated useful service life for a typical fighter airplane. The simulation was implemented by development of a computation technique based on the analog computer. Approximately 200 simulations were run for each of 11 assumed initial crack sizes, with the loading represented by a random noise signal filtered through a track-hold circuit to match a stress range exceedance distribution derived from an acceleration peak exceedance curve for the typical aircraft fleet. The resulting data were sampled at four fractions of simulated service life and then reduced to four final crack size histograms for each initial crack size. The raw data histograms were used to estimate parameter values for three-parameter Weibull distributions for final crack size in each case, and a regression analysis was performed to correlate the distributions for risk analysis. Mathematical risks of structural failure were computed and compared for several combinations of assumptions about the loading and the initial crack size distributions. Author (GRA)

N77-11043# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

INFLUENCE OF AIRCRAFT ANGLE OF ATTACK ON HIGH G COCKPIT DESIGN

Philip V. Kulwicki Mar. 1976 31 p refs
(AF Proj. 7184)
(AD-A025083; AMRL-TR-75-124) Avail: NTIS HC A03/MF A01 CSCL 01/3

The effects of aircraft angle of attack and flight path acceleration during high G fighter maneuvering on the position of the resultant G relative to the pilot are examined by means of a computer simulated dogfight engagement. It is demonstrated that a transient shifting in position of the resultant G relative to an aircraft vertical reference is correlated with variations in flight path acceleration, which occur due to pilot actuation of controls with attendant changes in flight path characteristics. Although time intervals during high G turns are noted wherein high values for aircraft angle of attack coincide with high values for the position of resultant G forward of aircraft vertical, these cases generally occur at subsonic (M equal to or less than 0.7) airspeeds and for the 'best' case for which the maximum power throttle setting is elected. For high G turns at transonic and supersonic speeds, the associated angle of attack is substantially reduced, as is the maximum inclination of resultant G forward of vertical for the best case of maximum power setting. Application of speed brakes or selection of an intermediate power setting has the effect of shifting the G-vector aft. It is concluded that the arbitrary addition of a large angle equal to the aircraft angle of attack to the ejection seat back angle to provide added pilot protection against high G forces is not warranted. Author (GRA)

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N77-11044*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RATIONALE AND DESCRIPTION OF A COORDINATED COCKPIT DISPLAY FOR AIRCRAFT FLIGHT MANAGEMENT

Daniel L. Baty Washington Nov. 1976 18 p refs
(NASA-TM-X-3457; A-6663) Avail: NTIS HC A02/MF A01 CSCL 01C

The design for aircraft cockpit display systems is discussed in detail. The system consists of a set of three beam penetration color cathode ray tubes (CRT). One of three orthogonal projects of the aircraft's state appears on each CRT which displays different views of the same information. The color feature is included to obtain visual separation of information elements. The colors of red, green and yellow are used to differentiate control, performance and navigation information. Displays are coordinated in information and color. B.B.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N77-11045# Lockheed-Georgia Co., Marietta.
V/STOL AIRCRAFT NOISE PREDICTION (JET PROPULSORS) Final Report, Jun. 1974 - Jun. 1975
N. N. Reddy, D. F. Blakney, J. G. Tibbets, and J. S. Gibson Jun. 1975 309 p refs Supersedes FAA-RD-73-145
(Contract DOT-FA72WA-3099)
(AD-A028765/6; LG75ER0054; FAA-RD-75-125; FAA-RD-73-145) Avail: NTIS HC A14/MF A01 CSCL 01/3

A computer program is presented for predicting the noise levels of V/STOL aircraft with jet-propulsive-lift systems. Using the equations developed in this report the noise levels may also be estimated with hand calculations. Vectored thrust, externally blown flap, upper surface blown flap, internally blown flap, and augmentor wing are the propulsive-lift concepts considered. Semi-empirical equations are derived using the test results and theories for the following aircraft noise sources: Internal engine, jet, excess (core engine), high-lift system, airframe, and auxiliary power unit. The computer program predicts the perceived noise levels and tone corrected perceived noise levels for V/STOL aircraft at any specified sideline distance for known geometrical and operational parameters. Author

N77-11046*# AiResearch Mfg. Co., Phoenix, Ariz.
COMPRESSOR BLADE SETTING ANGLE ACCURACY STUDY, VOLUME 1 Final Report
F. F. Holman and J. R. Kidwell Jun. 1976 107 p refs Sponsored by Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif. 2 Vol.
(Contract NAS3-18024)
(NASA-CR-135068-Vol-1; AiResearch-73-311305-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 21E

The aerodynamic test of a small, single stage, highly loaded, axial flow transonic compressor is covered. The stage was modified by fabricating a 24 blade rotor with mis-set blades in a repeating pattern - two degrees closed from nominal, two degrees open from nominal and nominal. The unit was instrumented to determine overall performance and average blade element data. High-response, dynamic pressure probes were installed to record pressure patterns at selected points in the flowpath. Testing was conducted at speeds from 70 to 94% of design equivalent speed with a conventional casing and also with circumferential grooves over the rotor tip. Testing indicated severe performance penalties were incurred as a result of the mis-set blading. Lower flow, pressure ratio, and efficiency were observed for the stage with or without casing treatment. Periodic pressure variations were detected at every location where high response pressure sensors were located and were directly related to blading geometry. Author

N77-11047*# AiResearch Mfg. Co., Phoenix, Ariz.
COMPRESSOR BLADE SETTING ANGLE ACCURACY STUDY. VOLUME 2: DATA COMPILATION Final Report
F. F. Holman and J. R. Kidwell Jun. 1976 133 p Sponsored by Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif. 2 Vol.
(Contract NAS3-18024)
(NASA-CR-135068-Vol-2; AiResearch-73-311305-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 21E
For abstract, see N77-11046.

N77-11048*# AiResearch Mfg. Co., Phoenix, Ariz.
SMALL AXIAL COMPRESSOR TECHNOLOGY, VOLUME 1
F. F. Holman, J. R. Kidwell, and T. C. Ware Jun. 1976 185 p refs Sponsored in part by Army
(Contract NAS3-17846)
(NASA-CR-134827-Vol-1; AiResearch-74-310862-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 21E

A scaled single-stage, highly-loaded, axial-flow transonic compressor was tested at speeds from 70 to 110% design equivalent speed to evaluate the effects of scaling compromises and the individual and combined effects of rotor tip running clearance and rotor shroud casing treatment on the overall and blade element performance. At design speed and 1% tip clearance the stage demonstrated an efficiency of 83.2% at 96.4% design flow and a pressure ratio of 1.865. Casing treatment increased design speed surge margin 2.0 points to 12.8%. Overall performance was essentially unchanged. An increase in rotor running clearance to 2.2%, with smooth casing, reduced design speed peak efficiency 5.7 points, flow by 7.4%, pressure ratio to 1.740, and surge margin to 5.4%. Reinstalling casing treatment regained 3.5 points in design speed peak efficiency, 4.7% flow, increased pressure ratio to 1.800 and surge margin to 8.7%. Author

N77-11049*# AiResearch Mfg. Co., Phoenix, Ariz.
SMALL AXIAL COMPRESSOR TECHNOLOGY, VOLUME 2 Final Report
F. F. Holman, J. R. Kidwell, and T. C. Ware Jun. 1976 329 p Sponsored in part by Army
(Contract NAS3-17846)
(NASA-CR-134827-Vol-2; AiResearch-74-310862-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 21E

Complete computer printout data are presented and supporting tests discussed in Volume I. Author

N77-11050*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMULATION OF FLIGHT-TYPE ENGINE FAN NOISE IN THE NASA-LEWIS 9X15 ANECHOIC WIND TUNNEL
M. F. Heidmann and D. A. Dietrich Nov. 1976 24 p refs Presented at the 92d Meeting of the Acoust. Soc. of Am., San Diego, Calif., 16-19 Nov. 1976
(NASA-TM-X-73540; E-8972) Avail: NTIS HC A02/MF A01 CSCL 20A

Flight type noise as contrasted to the usual ground static test noise exhibits substantial reductions in the time unsteadiness of tone noise, and in the mean level of tones calculated to be nonpropagating or cut-off. A model fan designed with cuttoff of the fundamental tone was acoustically tested in the anechoic wind tunnel under both static and tunnel flow conditions. The properties that characterize flight type noise were progressively simulated with increasing tunnel flow. The distinctly lobed directivity pattern of propagating rotor/stator interaction modes was also observed. Excess noise attributed to the ingestion of the flow disturbances that prevail near most static test facilities is substantially reduced with tunnel flow. Author

N77-11051*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF FORWARD VELOCITY ON NOISE FOR A J85 TURBOJET ENGINE WITH MULTITUBE SUPPRESSOR FROM WIND TUNNEL AND FLIGHT TESTS
James R. Stone, Jeffrey H. Miles, and Noel B. Sargent Nov. 1976 30 p refs Presented at the 92d Meeting of the Acoustical Soc. of Am., San Diego, Calif., 16-19 Nov. 1976
(NASA-TM-X-73542; E-8974) Avail: NTIS HC A03/MF A01 CSCL 20A

Flight and wind tunnel noise tests were conducted using a J85 turbojet engine as a part of comprehensive programs to obtain an understanding of forward velocity effects on jet exhaust noise. Nozzle configurations of primary interest were a 104-tube suppressor with and without an acoustically-treated shroud. The

installed configuration of the engine was as similar as possible in the flight and wind tunnel tests. Exact simultaneous matching of engine speed, exhaust velocity, and exhaust temperature was not possible, and the wind tunnel maximum Mach number was approximately 0.27, while the flight Mach number was approximately 0.37. The nominal jet velocity range was 450 to 640 m/sec. For both experiments, background noise limited the jet velocity range for which significant data could be obtained. In the present tests the observed directivity and forward velocity effects for the suppressor are more similar to predicted trends for internally-generated noise than unsuppressed jet noise.
Author

N77-11052*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MACROSCOPIC STUDY OF TIME UNSTEADY NOISE OF AN AIRCRAFT ENGINE DURING STATIC TESTS
B. J. Clark, M. F. Heidmann, and W. J. Kreim Nov. 1976 14 p refs Presented at the 92d Meeting of the Acoustical Soc. of Am., San Diego, Calif., 16-19 Nov. 1976
(NASA-TM-X-73556; E-8995) Avail: NTIS HC A02/MF A01 CSCL 20A

Static tests of aircraft engines can exhibit greater than 10 db random unsteadiness of tone noise levels because flow disturbances that prevail near test site facilities are ingested. Presumably such changes are related to installation and test site features. Some properties of unsteady noise observed during tests of a Lycoming YF-102 turbofan engine are presented. Time and spatial variations in tone noise obtained from closely spaced far field and inlet duct microphones are displayed. Long to extremely short intermittent tone bursts are observed. Unsteadiness of the tone, its harmonics, and the broadband noise show little similarity. In the far field, identity of tone bursts is retained over a directivity angle of less than 10 deg. In the inlet duct, tone bursts appear to propagate axially but exhibit little circumferential similarity. They show only slight relationship to tone bursts observed in the far field. The results imply an intermittent generation of random mixtures of propagating duct modes. Author

N77-11053*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CORE NOISE SOURCE DIAGNOSTICS ON A TURBOFAN ENGINE USING CORRELATION AND COHERENCE TECHNIQUES
Allen Karchmer and Meyer Reshotko 1976 27 p refs Presented at the ninety-second Meeting of the Acoust. Soc. of Am., San Diego, Calif. 16-19 Nov., 1976
(NASA-TM-X-73535; E-8961) Avail: NTIS HC A03/MF A01 CSCL 21E

Fluctuating pressure measurements at several locations within the core of a turbofan engine were made simultaneously with far field acoustic measurements. Correlation and coherence techniques were used to determine the relative amplitude and phase relationships between core pressures at these various locations and between the core pressures and far field acoustic pressure. The combustor is a low frequency source region for acoustic propagation through the core nozzle and out to the far field. The relation between source pressure and the resulting sound pressure involves a 180 degree phase shift and an amplitude transfer function which varies approximately as frequency squared. This is consistent with a simplified model using fluctuating entropy as a source term. Author

N77-11054*# AiResearch Mfg. Co., Phoenix, Ariz.
STUDY OF SMALL TURBOFAN ENGINES APPLICABLE TO SINGLE-ENGINE LIGHT AIRPLANES Final Report
G. L. Merrill Sep. 1976 118 p refs
(Contract NAS2-8582)
(NASA-CR-137944; AiResearch-76-211893) Avail: NTIS HC A06/MF A01 CSCL 21E

The design, efficiency and cost factors are investigated for application of turbofan propulsion engines to single engine, general aviation light airplanes. A companion study of a hypothetical engine family of a thrust range suitable to such aircraft and having a high degree of commonality of design features and parts is presented. Future turbofan powered light airplanes can have a lower fuel consumption, lower weight, reduced airframe maintenance requirements and improved engine overhaul periods as compared to current piston engined powered airplanes. Achievement of compliance with noise and chemical emission regulations is expected without impairing performance, operating cost or safety. Author

N77-11055*# National Aeronautics and Space Administration, Washington, D.C.
AIRCRAFT FUEL CONSERVATION TECHNOLOGY. TASK FORCE REPORT, SEPTEMBER 10,1975
10 Sep. 1975 141 p
(NASA-TM-X-74295) Avail: NTIS HC A07/MF A01 CSCL 21E

An advanced technology program is described for reduced fuel consumption in air transport. Cost benefits and estimates are given for improved engine design and components, turboprop propulsion systems, active control systems, laminar flow control, and composite primary structures. A.H.

N77-11056*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE AND EMISSION CHARACTERISTICS OF SWIRL-CAN COMBUSTORS TO NEAR-STOICHIOMETRIC FUEL-AIR RATIO
Larry A. Diehl and Arthur M. Trout Washington Nov. 1976 41 p refs
(NASA-TN-D-8342; E-8718) Avail: NTIS HC A03/MF A01 CSCL 21E

Emissions and performance characteristics were determined for two full annular swirl-can combustors operated to near stoichiometric fuel-air ratio. Test condition variations were as follows: combustor inlet-air temperatures, 589, 756, 839, and 894 K; reference velocities, 24 to 37 meters per second; inlet pressure, 62 newtons per square centimeter; and fuel-air ratios, 0.015 to 0.065. The combustor average exit temperature and combustor efficiency were calculated from the combustor exhaust gas composition. For fuel-air ratios greater than 0.04, the combustion efficiency decreased with increasing fuel-air ratios in a near-linear manner. Increasing the combustor inlet air temperature tended to offset this decrease. Maximum oxides of nitrogen emission indices occurred at intermediate fuel-air ratios and were dependent on combustor design. Carbon monoxide levels were extremely high and were the primary cause of poor combustion efficiency at the higher fuel-air ratios. Unburned hydrocarbons were low for all test conditions. For high fuel-air ratios SAE smoke numbers greater than 25 were produced, except at the highest inlet-air temperatures. Author

N77-11057*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD OF DISCRETE MODELING AND ITS APPLICATION TO ESTIMATION OF TF30 ENGINE VARIABLES
Dale J. Arpasi and William M. Bruton Oct. 1976 40 p refs
(NASA-TM-X-3443; E-8560) Avail: NTIS HC A03/MF A01 CSCL 21E

A method of discrete modeling is presented that effectively isolates steady state model accuracy from dynamic model accuracy. The steady state model may be generated from the engine design equations with any desired degree of accuracy. The dynamic model is generated by applying a step disturbance of a manipulated variable to an open loop engine simulation. The sampled response of the variable is combined with the steady state model's response to form a set of weighting factors. These weighting factors are then used to weight past values of the manipulated variable, thus forming the dynamic model. The method is used to estimate various TF30-P-3 engine variables. A dynamic trim function is developed to compensate for the dynamic nonlinearities of the variables as well as for inaccuracies in dynamic definition. The trim function is shown to be realted to the square root of the sum of the squares of the weighting factors obtained at various engine operating conditions. Finally, the estimation of variables without dynamic modeling is discussed. Author

N77-11058# Boeing Co., Wichita, Kans.
POWER TRANSFER UNITS FOR AIRCRAFT HYDRAULIC SYSTEMS Final Report, Dec. 1971 - Dec. 1975
W. E. Willard and J. D. Dudley Wright-Patterson AFB, Ohio AFAPL Jan. 1976 130 p

(Contract F33615-72-C-1078; AF Proj. 3145)
(AD-A024446; AFAPL-TR-76-4) Avail: NTIS HC A07/MF A01 CSCL 01/3

This report presents the results of a program to develop an advanced design hydraulic power transfer unit. The purpose of the program was to select and develop a power transfer unit with performance and stability improvements over that of the conventional rotary-piston type transfer units. The program was conducted in five phases: configuration selection, critical element testing, design, fabrication and prototype testing. The last three phases were repeated to produce two design improvements of the selected configuration. The selected configuration was an oscillating spool type motor -- pump which eliminated the power conversion, from linear to rotary back to linear, of the conventional rotary units. The first unit developed was a two cylinder configuration which exhibited a lockup mode at low flows. A second unit with three cylinders was developed with the design based on analysis accomplished on an analog computer. This unit exhibited three modes of operation as the flow rate increased from zero to maximum. The modes resulted from varying degrees of synchronization between the three pistons. This unit was then modified to provide a mechanical synchronize which resulted in a large improvement in stability at low flows. Minor areas of the basic design need to be explored to provide additional improvements. GRA

N77-11059# Purdue Univ., Lafayette, Ind.
PROJECT SQUID: A COOPERATIVE PROGRAM OF FUNDAMENTAL RESEARCH RELATED TO JET PROPULSION Semiannual Progress Report, 30 Sep. 1975 - 1 Apr. 1976
1 Apr. 1976 118 p refs
(Contract N00014-75-C-1143; NR Proj. 078-038; Proj. SQUID)
(AD-A024004) Avail: NTIS HC A06/MF A01 CSCL 21/5

Reports of progress during the past six months on the 21 research programs comprising Project SQUID are presented. The research programs fall into the areas of Aerodynamics and Turbomachinery, Combustion and Chemical Kinetics, Measurements and Turbulence. Project SQUID is a cooperative program of basic research related to jet propulsion. It is administered by Purdue University and sponsored by the Office of Naval Research. Author (GRA)

N77-11060# Ohio State Univ. Research Foundation, Columbus.
IGNITION, COMBUSTION, DETONATION AND QUENCHING OF REACTIVE MIXTURES Interim Technical Report, 1 Apr. 1974 - 31 Mar. 1975
Rudolph Edse Nov. 1975 126 p refs
(Grant AF-AFOSR-2511-73; AF Proj. 9711; OSURF Proj. 3641)
(AD-A024343; AFOSR-76-0503TR) Avail: NTIS HC A07/MF A01 CSCL 21/5

Measurements were made of pressures, wave and flame speeds in slightly confined and practically unconfined hydrogen air mixtures to study the mechanism of transition from deflagration to detonation. To shed further light on this phenomenon transition studies were also made in very long tubes. According to the results of these studies it appears that hydrogen-air clouds may detonate when the volume is sufficiently large. A rigorous analytical study was made of the performance of supersonic ramjets. The results of these calculations show that efficient operation involves impractical pressures in the combustion chamber and very large diffuser inlet and nozzle exit areas. Author (GRA)

N77-11061# New York Univ., Westbury. Aerospace and Energetics Lab.
INVESTIGATION OF SLOT COOLING FOR HIGH-SPEED AIRCRAFT Final Report, 1 Aug. 1971 - 30 Sep. 1975
Antonio Ferri Dec. 1975 23 p refs
(Grant AF-AFOSR-2167-72; AF Proj. 6813; AF Proj. 9781)
(AD-A024316; AFOSR-76-0505TR) Avail: NTIS HC A02/MF A01 CSCL 21/5

Active film cooling for gas turbine blades has been investigated. Upstream injection at the leading edge and tangential injection downstream has been used to protect the blade. GRA

N77-11062# Engelhard Minerals and Chemicals Corp., Edison, N.J. Research and Development Dept.
HIGH TEMPERATURE THERMOCOUPLE SYSTEM FOR ADVANCED AIRCRAFT TURBINE ENGINES Final Technical Report, 1 Aug. 1974 - 31 Dec. 1975
D. A. Toenshoff and E. D. Zysk Wright-Patterson AFB, Ohio AFAPL 31 Dec. 1975 109 p refs
(Contract F33615-74-C-2069; AF Proj. 3066)
(AD-A025500; AFAPL-TR-75-108) Avail: NTIS HC A06/MF A01 CSCL 21/5

This is a final report covering the development of a temperature measuring system for the very high temperature gas streams found in advanced jet engines. The measurement system is a thermocouple probe assembly suitable for interfacing to the Detroit Diesel-Allison GMA 200 Joint Technology Demonstration Engine. Average temperatures of the order of 2600-2700F (1425-1480C) will have to be measured and it is anticipated that hot spots to 3000F (1650C) will be encountered. This study covered the selection of an optimum thermocouple (Pt-40% Rh vs. Pt-0.6% ThO2); compatible compensating extension lead wire (base metal) usable to around 750C in air (Nichrome vs. EA 9R-682); high temperature resisting sheath and shield tube material (Pt-0.6% ThO2); crushable MgO insulation; design of a temperature probe using the optimum materials and vibration testing at 1450C of one of the finished probes. The selected probe passed the high temperature vibration test successfully. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N77-11063*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION OF AN AUTOMATICALLY-CONTROLLED STOL AIRCRAFT IN A MICROWAVE LANDING SYSTEM MULTIPATH ENVIRONMENT
Mitsuhiko Toda, Stuart C. Brown, and Clifford N. Burrous Jul. 1976 42 p refs
(NASA-TM-X-73154; A-6693) Avail: NTIS HC A03/MF A01 CSCL 17G

The simulated response is described of a STOL aircraft to Microwave Landing System (MLS) multipath errors during final approach and touchdown. The MLS azimuth, elevation, and DME multipath errors were computed for a relatively severe multipath environment at Crissy Field California, utilizing an MLS multipath simulation at MIT Lincoln Laboratory. A NASA/Ames six-degree-of-freedom simulation of an automatically-controlled deHavilland C-8A STOL aircraft was used to determine the response to these errors. The results show that the aircraft response to all of the Crissy Field MLS multipath errors was small. The small MLS azimuth and elevation multipath errors did not result in any discernible aircraft motion, and the aircraft response to the relatively large (200-ft (61-m) peak) DME multipath was noticeable but small. Author

N77-11064*# Boeing Aerospace Co., Seattle, Wash.
PRELIMINARY DESIGN-LIFT/CRUISE FAN RESEARCH AND TECHNOLOGY AIRPLANE FLIGHT CONTROL SYSTEM Final Report
Philip Gotlieb, George E. Lewis, and Leo J. Little Nov. 1976 106 p refs
(Contract NAS2-9177)
(NASA-CR-137971; D180-20216-1) Avail: NTIS HC A06/MF A01 CSCL 01C

This report presents the preliminary design of a stability augmentation system for a NASA V/STOL research and technology airplane. This stability augmentation system is postulated as the simplest system that meets handling qualities levels for research and technology missions flown by NASA test pilots. The airplane studied in this report is a T-39 fitted with tilting lift/cruise fan nacelles and a nose fan. The propulsion system features a shaft interconnecting the three variable pitch

fans and three power plants. The mathematical modeling is based on pre-wind tunnel test estimated data. The selected stability augmentation system uses variable gains scheduled with airspeed. Failure analysis of the system illustrates the benign effect of engine failure. Airplane rate sensor failure must be solved with redundancy. Author

N77-11065# Rockwell International Corp., Columbus, Ohio. Aircraft Div.

DESIGN AND FABRICATION OF AN 8000 PSI CONTROL-BY-WIRE ACTUATOR FOR FLIGHT TESTING IN A T-2 C AIRPLANE Final Report, 28 Mar. 1975 - 5 Jan. 1976

Joseph N. Demarchi and Robert K. Haning Jan. 1976 45 p refs

(Contract N62269-75-C-0311)

(AD-A024487; NR76H-1; NADC-76049-30) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report describes the design and fabrication of an 8000 psi control-by-wire hydraulic rudder actuator for future flight testing in a T-2C airplane. Actuator output is commanded by a single stage spool/sleeve valve driven directly by a permanent magnet force motor. Actuator design criteria were based on T-2C aerodynamic considerations and envelope constraints. A system analysis was conducted to determine heat dissipation and hydraulic line sizes and routing. Modifications required on the T-2C airplane to accommodate the test system installation were outlined. Author (GRA)

N77-11066# Instrument Flight Center, Randolph AFB, Tex.

HELICOPTER YAW AXIS AUGMENTATION INVESTIGATION

William E. Clark and Gabriel P. Intano Mar. 1976 147 p

(AD-A024512; IFC-TR-76-3) Avail: NTIS HC A07/MF A01 CSCL 01/3

This investigation was conducted to document changes in pilot performance and activity resulting from augmentation of the helicopter yaw axis. Subject pilot opinions regarding workload and pilot acceptance of the concept of yaw augmentation were also evaluated. Eight highly qualified instructor pilots were used as data collection pilots. These pilots flew profiles representing typical helicopter instrument maneuvers. Each maneuver, except for the instrument takeoff flown augmented only, was flown first with the yaw-augmentation system engaged and then repeated without yaw-augmentation. Objective and subjective data was obtained through the use of video, audio, oscillograph recording equipment and in-flight and postflight questionnaires and debriefings. Due to the lack of large scale computer facilities for objective data analysis, an interim report is being published. A final report utilizing correlation and regression analysis, documenting cause and effect relationships will be published when computer facilities are available. The present interim report provides limited objective data analysis and project personnel interpretation of the subjective data. Author (GRA)

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N77-11067*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE LANGLEY THERMAL PROTECTION SYSTEM TEST FACILITY: A DESCRIPTION INCLUDING DESIGN OPERATING BOUNDARIES

George F. Klich Nov. 1976 31 p ref

(NASA-TM-X-73973) Avail: NTIS HC A03/MF A01 CSCL 14B

A description of the Langley thermal protection system test facility is presented. This facility was designed to provide realistic environments and times for testing thermal protection systems proposed for use on high speed vehicles such as the space shuttle. Products from the combustion of methane-air-oxygen mixtures, having a maximum total enthalpy of 10.3 MJ/kg, are used as a test medium. Test panels with maximum dimensions of 61 cm x 91.4 cm are mounted in the side wall of the test region. Static pressures in the test region can range from .005 to .1 atm and calculated equilibrium temperatures of test panels range from 700 K to 1700 K. Test times can be as long as 1800 sec. Some experimental data obtained while using combustion products of methane-air mixtures are compared with theory, and calibration of the facility is being continued to verify calculated values of parameters which are within the design operating boundaries. Author

N77-11068*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

ACOUSTICAL EVALUATION OF THE NASA LANGLEY V/STOL WIND TUNNEL

Istvan L Ver [1976] 45 p refs

(Contract NAS1-9559)

(NASA-CR-145087; Rept-2288) Avail: NTIS HC A05/MF A01 CSCL 20A

The results are presented of the acoustical measurements made to supply NASA Langley operating personnel with the acoustical characteristics of the tunnel test section needed for the planning of acoustical measurements and to identify the major noise sources. The results of the preliminary measurements of the spatial distribution of the sound field in the closed tunnel configuration indicate that the total sound power output of an unknown sound source placed in the test section could most probably be evaluated by measuring the sound pressure in two properly chosen locations in the duct - one upstream and one downstream of the test section. However, it is recommended that the practicability of this method of sound power output measurements be further investigated, preferably in a small scale model of the V/STOL Tunnel. Author

N77-11069*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MACH 4 FREE-JET TUNNEL STARTING EXPERIMENTS FOR A HYPERSONIC RESEARCH ENGINE MODEL CAUSING HIGH BLOCKAGE

George T. Carson, Jr. and Raymond E. Midden Washington Nov. 1976 54 p refs

(NASA-TM-X-3418; L-10525) Avail: NTIS HC A04/MF A01 CSCL 14B

Tests of a full scale hypersonic research engine (HRE) were conducted in the hypersonic tunnel facility at Mach numbers of 5, 6, and 7. Since the HRE would cause a rather high blockage (48.83 percent of the nozzle area), subscale tests were conducted in various available small wind tunnels prior to the full scale tests to study the effects of model blockage on tunnel starting. The results of the Mach 4 subscale tests which utilized a model system at 0.0952 scale which simulated the HRE in the test section of the tunnel are presented. A satisfactory tunnel starting could not be achieved by varying the free jet length or diffuser size nor by inserting the model into the test stream after tunnel starting. However, the installation of a shroud around the HRE model allowed the tunnel to start with the model preset in the tunnel at a tunnel stagnation pressure to atmospheric exit pressure ratio of 13.4. The simulation of the discharge of instrumentation cooling water and the addition of test hardware at the aft end of the HRE model did not have a significant effect on the tunnel starting. Author

N77-11070# Advisory Group for Aerospace Research and Development, Paris (France).

ON THE FLOW QUALITY NECESSARY FOR THE LARGE EUROPEAN HIGH-REYNOLDS-NUMBER TRANSONIC WINDTUNNEL LEHRT

J. P. Hartzuiker (National Aero- and Astronautical Res. Inst., Amsterdam), P. G. Pugh (Royal Aircraft Estab., Bedford, Engl.), W. Lorenz-Meyer (DFVLR, Goettingen, Germany), G. E. Fasso (ONERA, Chatillon sous Bagneux, France), and D. Kuechemann, ed. (Royal Aircraft Estab., Farnborough, Engl.) Mar. 1976 31 p refs

(AGARD-R-644; ISBN-92-835-1214-6) Avail: NTIS HC A03/MF A01

The Large European High Reynolds Number Transonic

Windtunnel (LEHRT) is meant to provide aerodynamic data at high Reynolds numbers of high standard in a relatively short running time (dictated by economic reasons). This implies that the flow quality in LEHRT has to be excellent. Quantitative requirements for turbulence level as well as for pressure fluctuations have been developed in this report. Author

N77-11071# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

THE EFFECT OF FINITE TEST SECTION LENGTH ON WALL INTERFERENCE IN 2-D VENTILATED WIND TUNNELS

J. W. Slooff and W. J. Piers Oct. 1975 13 p refs Presented at the AGARD FDP Symp. on Wind Tunnel Design and Testing Tech., London, 6-10 Oct. 1975

(NLR-MP-75036-U) Avail: NTIS HC A02/MF A01

A new mathematical model for two-dimensional subsonic ventilated wall interference calculations is presented. It is based on a modified homogeneous boundary condition that takes into account the finite length of the ventilated parts of the tunnel wall as well as certain nonlinear effects. To facilitate computational treatment, the full nonlinear problem is reduced to a sequence of linear problems by a consistent expansion to the second order of the perturbation velocity into powers of the chord to height ratio, which is assumed to be small. The linear problems are subsequently solved by means of the method of discretized singularity distributions. The results obtained indicate that the length to the height ratio of the test section is an important parameter for tunnels with separated top and bottom plenums. In addition, model position and plenum pressure can be used to minimize wall interference effects. ESA

N77-11072# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

DESIGN AND PERFORMANCE OF THE FOUR-DEGREES-OF-FREEDOM MOTION SYSTEM OF THE NLR RESEARCH FLIGHT SIMULATOR

W. P. Koevermans and C. J. Jansen 6 Oct. 1975 14 p Presented at the AGARD FMP/GCP Joint Symp. on Flight Simulation/ Guidance Systems Simulation, The Hague, 20-24 Oct. 1975

(NLR-MP-75038-U) Avail: NTIS HC A02/MF A01

The motion system of the flight simulator with freedom of motion in heave, roll, pitch, and yaw is described. To give good motion cues without jerks, hydraulic jacks were developed in which stick-slip phenomena are eliminated by introducing hydrostatic bearings between the moving piston and rod and the fixed cylinder, resulting in an acceleration threshold level below 0.01 g. A mathematical model was prepared to simulate and study the behavior of the hydraulic jacks. Results are given of measurements on single jacks and on the complete system, comprising acceleration noise and threshold level, dynamic response, and performance diagrams. Because of the required oil pressure for the hydrostatic bearing, special operating procedures have to be followed. A description is given of these as well as of the principles of the safety system applied.

Author (ESA)

N77-11073# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Experimentelle Aerodynamik.

DESCRIPTION OF THE MODEL SUBSONIC WIND TUNNEL (MUK) FOR THE LARGE SUBSONIC TUNNEL (GUK). CONSTRUCTION, START-UP, OPERATION, FIRST RESULTS [BESCHREIBUNG DES MODELL-UNTERSCHALLWINDKANALS (MUK) ZUM GROSSEN UNTERSCHALLKANAL (GUK). ERSTELLUNG, INBETRIEB-NAHME, ERSTE ERGEBNISSE]

R. Mueller Dec. 1975 24 p refs In GERMAN

(Contract BMFT-512-8791-WRT-4054)

(DLR-IB-151-75/14) Avail: NTIS HC A02/MF A01

The model for the large subsonic wind tunnel, constructed from December 1973 to February 1975 at DFVLR, Brunswick, is reviewed. First results of tests during the start-up operation and of basic measurements are presented. ESA

N77-11074# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.

FLOW DIRECTION MEASUREMENTS IN THE TANDEM TEST SECTIONS OF THE MODEL SUBSONIC WIND TUNNEL (MUK) [STROEMUNGSRICHTUNGSMESSUNGEN IN DEN TANDEM-MESSTRECKEN DES MODELL-UNTERSCHALLKANALS (MUK)]

K. J. Schultz Jan. 1976 28 p refs In GERMAN

(DLR-IB-151-76/1) Avail: NTIS HC A03/MF A01

Flow direction measurements carried out as part of a series of measurements in the hot sections of the model subsonic wind tunnel at DFVLR, Brunswick, are reported. The test method, using a 5-hole probe, its set-up, its execution, and the evaluation of test results are described. Direction deviations from the main test section flows are presented in diagrams. ESA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N77-11075*# Joint Publications Research Service, Arlington, Va.

SPACE IS FOR MAN

A. D. Koval and G. P. Uspenskiy Washington NASA May 1975 161 p refs Transl. into ENGLISH of the book "Kosmos Cheloveku" Moscow, Mashinostroyeniye Press, 1974 p 1-199 (NASA Order W-13183)

(NASA-TT-F-16254) Avail: NTIS HC A08/MF A01 CSCL 22A

The value of space research for mankind, present and future, is discussed in popular form. Information is presented on the historical prerequisites for the birth of modern astronautics, on the principles of construction of various pieces of space equipment, on flights of automatic spacecraft, and on piloted spacecraft and long-term manned scientific stations. Author

N77-11076*# Joint Publications Research Service, Arlington, Va.

SPACE LAUNCHES AND FINISHES

I. G. Borisenko Washington NASA Nov. 1976 78 p Transl. into ENGLISH from the book "Na Kosmicheskikh Startakh i Finishakh" Moscow, Znaniye Press, 1975 p 3-76, 130-147 (NASA Order W-13183)

(NASA-TT-F-17278) Avail: NTIS HC A05/MF A01 CSCL 22A

A chronological account is given of preparations for and implementation of the Russian manned space program from its inception through the Soyuz-Apollo program as seen through the eyes of a Russian sports commissar who was always on the scene of launchings and landings of Soviet cosmonauts.

Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N77-11077*# McDonnell-Douglas Astronautics Co., Houston, Tex. Astronautics Div.

NAVIGATION INPUT TO LEVEL C OFT NAVIGATION FUNCTIONAL SUBSYSTEM SOFTWARE REQUIREMENTS (RENDEZVOUS ONORBIT-2)

J. V. Dees, L. M. Duncan, J. J. Ewell, M. L. Howard, M. J. Little, D. A. Lukaszewski, R. C. Pocklington, and J. L. Spencer 22 Oct. 1976 523 p

(Contract NAS9-14960)

(NASA-CR-151007; DN-1.4-8-015) Avail: NTIS HC A22/MF A01 CSCL 22A

Navigation software design requirements are presented for the orbital flight test phase of space shuttle. Computer loads for the entire onorbit-2 operation are documented. Author

N77-11078*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Astronautics Div.

PARAMETRIC STUDY OF PREDICTOR ACCURACY IMPACT

ON OFT RENDEZVOUS TARGETING
Stephen W. Glenn 8 Oct. 1976 44 p refs
(Contract NAS9-14960)
(NASA-CR-151094; DN-1.4-9-01) Avail: NTIS HC A03/MF A01 CSCL 22A

A parametric study was made to quantitatively define the effects of errors in the state vector predictor used by the Operational Flight Trainer (OFT) rendezvous targeting algorithms. The effect of the predictor accuracy on the OFT rendezvous profile is shown by the sensitivity of various critical rendezvous parameters with respect to downrange and radial predictor error rates. The effect of both inertial (same errors on both vehicles) and relative (differential errors on one vehicle with respect to the other) errors were considered. Relative radial error rates had the largest impact on the rendezvous followed by relative downrange errors, radial inertial errors and downrange inertial errors. Author

N77-11079*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TETHERLINE SYSTEM FOR ORBITING SATELLITES Patent Application
Charles C. Rupp and Ralph R. Kissel, inventors (to NASA) Filed 8 Nov. 1976 11 p
(NASA-Case-MFS-23564-1; US-Patent-Appl-SN-739908) Avail: NTIS HC A02/MF A01 CSCL 22A

A system for tethering one orbiting space vehicle to another in which a tetherline between the vehicles is controlled by a motorized reel is discussed. The reel is controlled to deploy, retrieve, or maintain a constant line length while effecting a stabilizing influence on the line. This is accomplished by applying a tension to the line which takes into account the instantaneous length of the line, rate of change of the length of the line, and certain constants which vary depending upon the mode of operation, deployment, retrieval, or station keeping. NASA

N77-11080# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
COMPUTATIONAL RESULTS OF THE NISLAP AND AIMLASER PROGRAMS FOR SATELLITE POSITION PREDICTIONS
K. F. Wakker, B. A. C. Ambrosius, and H. J. D. Piersma Mar. 1976 28 p
(VTH-212) Avail: NTIS HC A03/MF A01

Two programs available for the prediction of geodetic satellite orbits are briefly outlined. They will be applied to the automatic pointings of a ground-based laser at geodetic satellites equipped with laser reflectors. At the moment satellites GEOS-1, GEOS-2, GEOS-3, Starlette, and Explorer 27 are envisaged to be used for the laser measurements. To gain information on the accuracy of these computer programs and on the specific effects of the various perturbing forces on the predicted satellite position, a number of computer runs were made in which the input data and the perturbations model were varied systematically. The computations were performed for observations from the Wiesel Station, situated near Kootwijk. This was done because from that station some optical observations verifying the prediction results could be expected. The computation results were compared for the different runs. As contrasted with actual laser operations, which only indicate whether or not a satellite is hit and not how far the laser beam went wide, these test runs can give some physical insight into the computational process and the pointing accuracies to be expected. Author (ESA)

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air)*.

N77-11081*# Missouri Univ., Rolla. Cloud Physics Research Center.
PRELIMINARY AEROSOL GENERATOR DESIGN STUDIES Final Report
Joseph F. Stampfer, Jr. 1976 49 p
(Contract NAS8-31538)
(NASA-CR-150050) Avail: NTIS HC A03/MF A01 CSCL 14B

The design and construction of a prototype vaporization generator for highly dispersed sodium chloride aerosols is described. The aerosol generating system is to be used in the Science Simulator of the Cloud Physics Laboratory Project and as part of the Cloud Physics Laboratory payload to be flown on the shuttle/spacelab. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N77-11082 California Univ., Los Angeles.
OPTIMAL MULTIPLE-ARC TRAJECTORIES FOR AN ALL-ASPECT AIR-TO-AIR MISSILE Ph.D. Thesis
Richard Arnten Lawhern 1976 246 p
Avail: Univ. Microfilms Order No. 76-22201

A three-phase algorithm of steepest descent is developed to investigate the nature of optimal turning strategies in the all-aspect air to air missile. The missile is aimed in approximately the correct direction for interception. The burnout velocity of the missile is maximized with burnout velocity angle constrained to the proper direction for interception. The terminal line of sight angle rate is minimized subject to a constraint on terminal closing range. The algorithm is tested in missile engagements for which optimal behavior is known. Optimal burnout velocity is typically obtained within 5% in 15 total iterations of the algorithm. During trajectory angle optimization, accuracies typical of miss distances less then 100 feet are obtained for all engagements. Several missile-target engagements are examined. Dissert. Abstr.

N77-11083*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SPACE STATION SYSTEMS ANALYSIS STUDY. PART 1, VOLUME 3: APPENDICES. BOOK 1: OBJECTIVE DATA Final Report
1 Sep. 1976 513 p refs
(Contract NAS9-14958)
(NASA-CR-151104; MDC-G6508-Pt-1-Vol-3-Bk-1) Avail: NTIS HC A22/MF A01 CSCL 22B

The space systems objective evaluation program for determining the requirements for a space station is reported. Forms for this evaluation are included along with objective data packages for the following systems: (1) satellite power system, (2) nuclear energy, (3) earth sciences, (4) space cosmological research and development, (5) space processing, (6) cluster support, (7) depot, (8) multidiscipline science laboratory, (9) sensor development, and (10) living and working space. F.O.S.

N77-11084*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SPACE STATION SYSTEMS ANALYSIS STUDY. PART 1, VOLUME 1: EXECUTIVE STUDY
1 Sep. 1976 41 p
(Contract NAS9-14958)
(NASA-CR-151102; MDC-G6508-Pt-1-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 22B

Potential space station system options were examined for a permanent, manned, orbital space facility and to provide data to NASA program planners and decision makers for their use in future program planning. There were ten space station system objectives identified. These were categorized into five major objectives and five supporting objectives. The major objectives were to support the development of: (1) satellite power systems, (2) nuclear energy plants in space, (3) space processing, (4) earth services, and (5) space cosmological research and development. The five supporting objectives, to define space

facilities which would be basic building blocks for future systems, were: (1) a multidiscipline science laboratory, (2) an orbital depot to maintain, fuel, and service orbital transfer vehicles, (3) cluster support systems to provide power and data processing for multiple orbital elements, (4) a sensor development facility, and (5) the facilities necessary to enhance man's living and working in space. S.M.

N77-11085*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SPACE STATION SYSTEMS ANALYSIS STUDY. PART 1, VOLUME 2: TECHNICAL REPORT Final Report
1 Sep. 1976 252 p refs
(Contract NAS9-14958)
(NASA-CR-151103; MDC-G6508-Pt-1-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 22B
For abstract, see N77-11084.

N77-11086*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.
PROGRAMMABLE DATA COLLECTION PLATFORM STUDY Final Report
May 1976 259 p
(Contract NAS5-22495)
(NASA-CR-144819) Avail: NTIS HC A12/MF A01 CSCL 22B

The results of a feasibility study incorporating microprocessors in data collection platforms in described. An introduction to microcomputer hardware and software concepts is provided. The influence of microprocessor technology on the design of programmable data collection platform hardware is discussed. A standard modular PDCP design capable of meeting the design goals is proposed, and the process of developing PDCP programs is examined. A description of design and construction of the UT PDCP development system is given. Author

N77-11087*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF MODIFICATIONS TO THE SPACE SHUTTLE ENTRY GUIDANCE AND CONTROL SYSTEMS
Richard W. Powell, Howard W. Stone, and Lawrence F. Rowell Washington Oct. 1976 86 p refs
(NASA-TN-D-8273; L-10408) Avail: NTIS HC A05/MF A01 CSCL 22C

A nonlinear six degree of freedom entry simulation study was conducted to identify space shuttle guidance and control system software modifications which reduce the control system sensitivity to the guidance system sampling frequency. Several modifications which eliminated the control system sensitivity and associated control limit cycling were examined. The result of the modifications was a reduction in required reaction control system fuel. Author

N77-11088# Appleton Lab., Slough (England).
PHASE A STUDY OF SPACELAB-BORNE ATMOSPHERIC PASSIVE EXPERIMENTS. VOLUME 2: SCIENTIFIC OBJECTIVES AND PASSIVE SOUNDER INSTRUMENTS Final Report
[1976] 244 p refs 5 Vol.
(Contract ESA-SC/97-HQ)
(ESA-CR(P)-836-Vol-2) Avail: NTIS HC A11/MF A01

Developments in atmospheric science up to 1980, and the scientific objectives for atmospheric science on the first and subsequent Spacelab missions, are presented. Spacelab's resources are summarized. Types of passive sounder instruments are outlined. They include instruments for measurement of atmospheric wind, temperature, composition, and aerosol. The objectives for Spacelab-borne lidar are also mentioned. Model objectives for typical passive sounder payloads are suggested. ESA

N77-11089# Appleton Lab., Slough (England).
PHASE A STUDY OF SPACELAB-BORNE ATMOSPHERIC PASSIVE EXPERIMENTS. VOLUME 3: ACCOMMODATION OF INSTRUMENTS AND PACKAGES ON SPACELAB Final Report
[1976] 373 p refs 5 Vol.
(Contract ESA-SC/97-HQ)
(ESA-CR(P)-836-Vol-3) Avail: NTIS HC A16/MF A01

A detailed description of various aspects of Spacelab in relation to individual instruments for passive sounding, and also with particular consideration of the model payloads suggested, is presented. Packages of combined instruments for both the first Spacelab and later missions are considered. ESA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N77-11090*# Chrysler Corp., New Orleans, La. Space Div.
AN INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF A 0.00548 SCALE MODEL (MODEL NO. 486) OF THE SPACE SHUTTLE 146-INCH DIAMETER SOLID ROCKET BOOSTER AT ANGELS OF ATTACK FROM 113 DEG TO 180 DEG IN THE AEDC PWT 4-FOOT TRANSONIC WIND TUNNEL (SA16F)
Paul E. Ramsey (NASA. Marshall Space Flight Center) Oct. 1976 88 p refs
(Contract NAS9-13247)
(NASA-CR-147648; DMS-DR-2334) Avail: NTIS HC A05/MF A01 CSCL 01A

An experimental investigation (SA16F) was conducted in the AEDC PWT 4T to determine the entry static stability of a 0.00548 scale space shuttle solid rocket booster (SRB). The primary objective was to improve the definition of the aerodynamic characteristics in the angle of attack range beyond 90 deg in the vicinity of the entry trim point. The SRB scale model consisted of the reentry configuration with all major protuberances. A simulated heat shield around the engine nozzle was also included. Data were obtained for a 60 deg side mounted sting and a straight nose mounted sting. The angle of attack range for the side mounted sting was 113 deg to 147 deg and for the nose mounted sting 152 deg to 187 deg. The Mach number range consisted of 0.4 to 1.2 at roll angles of 0 and 90 deg. The resulting 6-component aerodynamic force data was presented as the variation of coefficients with angle of attack for each Mach number and roll angle. Author

N77-11091*# Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
DETAILED DESIGN SPECIFICATION FOR THE ALT SHUTTLE INFORMATION EXTRACTION SUBSYSTEM (SIES)
G. L. Clouette and W. N. Fitzpatrick Jul. 1976 176 p
(Contract NAS9-12200)
(NASA-CR-151097; LEC-9104A; JSC-11468) Avail: NTIS HC A09/MF A01 CSCL 22B

The approach and landing test (ALT) shuttle information extraction system (SIES) is described in terms of general requirements and system characteristics output products and processing options, output products and data sources, and system data flow. The ALT SIES is a data reduction system designed to satisfy certain data processing requirements for the ALT phase of the space shuttle program. The specific ALT SIES data processing requirements are stated in the data reduction complex approach and landing test data processing requirements. In general, ALT SIES must produce time correlated data products as a result of standardized data reduction or special purpose analytical processes. The main characteristics of ALT SIES are: (1) the system operates in a batch (non-interactive) mode; (2) the processing is table driven; (3) it is data base oriented; (4) it has simple operating procedures; and (5) it requires a minimum of run time information. Author

N77-11092*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
SPACE SHUTTLE CONTAMINATION DUE TO BACKFLOW FROM CONTROL MOTOR EXHAUST Final Report
S. J. Robertson, S. T. K. Chan, and A. L. Lee Oct. 1976 39 p refs
(Contract NAS8-31440)

(NASA-CR-150054; LMSC-HREC-TR-D568000) Avail: NTIS HC A03/MF A01 CSCL 22B

Spacecraft contamination of the space shuttle orbiter and accompanying Spacelab payloads is studied. The scattering of molecules from the vernier engines and flash evaporator nozzle after inpingement on the orbiter wing surfaces, and the backflow of molecules out of the flash evaporator nozzle plume flow field due to intermolecular collisions in the plume are the problems discussed. A method was formulated for dealing with these problems, and detailed results are given. Author

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

N77-11093*# Scientific Translation Service, Santa Barbara, Calif.
DESCRIPTION OF THE UNIVERSAL PROGRAM FOR CALCULATING THE NAVIGATIONAL INFORMATION ON THE LOCATION OF AN ARTIFICIAL EARTH SATELLITE
V. I. Prokhorenko Washington NASA Nov. 1976 82 p refs Transl. into ENGLISH of "Opisaniye Universal'noy Programmy Rascheta Navigatsionnoy Inform. o Polozhenii Iskustvennogo Sputnika Zemli" Moscow, Acad. of Sci. of the USSR, Inst. of Space Res., 1976 p 1-80
(Contract NASw-2791)
(NASA-TT-F-17273; PR-263) Avail: NTIS HC A05/MF A01 CSCL 22A

The logic in the universal program for calculating navigational information written in FORTRAN language is considered. Its capabilities and methods of accomplishing the capabilities are described. Author

N77-11094# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
VISIBILITY INVESTIGATIONS FOR THE SYMPHONIE A AND B SATELLITES
E. F. Jochim 1 Apr. 1976 131 p refs In GERMAN; ENGLISH summary
(DLR-IB-552-74/5) Avail: NTIS HC A07/MF A01

Some results of the station and satellite attitude sensor visibility investigations for the injection of the geostationary satellites Symphonie A and B are presented in diagrams and tables. The computations were carried out for mission planning and for the operational injection phase. Author (ESA)

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N77-11095 California Univ., Los Angeles.
VIBRATION OF A FLEXIBLE SPACECRAFT WITH MOMENTUM EXCHANGE CONTROLLERS Ph.D. Thesis
Joseph Reed Canavin 1976 172 p
Avail: Univ. Microfilms Order No. 76-22179

A modified Tisserand constraint is introduced to define a floating reference frame with similar properties for an elastic body which contains a spinning rotor. Finite element equations of motion are derived for a completely flexible spacecraft with momentum exchange controllers, using a modified Tisserand frame. A modal analysis is performed for the system and the resulting set of equations is reduced in number by a truncation procedure for more efficient system simulation. A continuum analysis is performed for a simple physical system consisting of a uniform beam and an axisymmetric rotor. Dissert. Abstr.

N77-11096*# California Univ., Los Angeles. School of Engineering and Applied Science.
VIBRATION OF A FLEXIBLE SPACECRAFT WITH MOMENTUM EXCHANGE CONTROLLERS
J. R. Canavin Jun. 1976 168 p refs
(Contract NAS8-28358)
(NASA-CR-150058; UCLA-ENG-7631) Avail: NTIS HC A08/MF A01 CSCL 22B

Floating reference frames were investigated in order to allow first order vibration analysis in the presence of large system rotations. When the deformations of an elastic continuum are expanded in terms of the free-free modes of an unconstrained system, the rigid body modes are found to be fixed relative to the Tisserand frame, with respect to which the relative momentum is zero. The proof presented for this is based on the orthogonality condition for modes with distinct natural frequencies. This result also guarantees the independence of coordinates for all modes with nonzero natural frequencies. A Modified Tisserand Constraint is introduced in order to define a floating reference frame with similar properties for an elastic body which contains a spinning rotor. Finite element equations of motion are derived for a completely flexible spacecraft with momentum exchange controllers, using a Modified Tisserand Frame. The deformable systems covered in this application are assumed to undergo only small rotations, and therefore the rotor torques must formally be small, although in engineering applications it may be possible to relax this constraint. A modal analysis is performed for the system and the resulting set of equations is reduced in number by a truncation procedure for more efficient system simulation. Author

N77-11097# National Aerospace Lab., Amsterdam (Netherlands). Space Flight Technology Div.
ANALYSIS OF THE PERTURBED MOTION OF ASYMMETRIC, SPINNING SPACECRAFT
P. T. L. M. VanWoerkom 22 Feb. 1975 46 p refs
(NLR-TR-75043-U) Avail: NTIS HC A03/MF A01

Following a description of the various mathematical approaches to the problem, the class of restricted, perturbed motion was analyzed using the Poincare asymptotic expansion procedure. Explicit first order analytical solutions are presented for the components of the angular velocity vector and for the attitude angles, as functions of time, for spinning, asymmetric spacecraft acted upon by both body and inertially fixed torques. The solutions are analyzed in geometric form, and the results are compared with those available in literature. Applications and areas for further research are discussed. Author (ESA)

N77-11098# ARO, Inc., Arnold Air Force Station, Tenn.
HEAT-TRANSFER TESTS ON THE ROCKWELL INTERNATIONAL SPACE SHUTTLE ORBITER WITH BOUNDARY-LAYER TRIPS (OH-54) Final Report, Oct. 1974 - Sep. 1975
D. B. Carver AEDC May 1976 43 p refs
(ARO Proj. V41B-82A; AF Proj. 921E)
(AD-A024553; ARO-VKF-TR-75-165; AEDC-TR-76-28) Avail: NTIS HC A03/MF A01 CSCL 22/2

Aerothermodynamic transition tests on a model of the forward half of the Rockwell International Space Shuttle Orbiter Configuration 140C were conducted at Mach Number 8. Phase-change paint was used to determine the aerodynamic heating rates on the windward side of orbiter models during simulated atmospheric reentry. The majority of the data was obtained using spherical trip elements of varying sizes at three different axial stations along the model to determine the effect of roughness size and location on boundary-layer transition. Additional data were taken with models which had scale indentations that simulated external tank attachment rings, nose wheel well doors, and a surface insulation interface gap. Data were taken over an angle-of-attack range from 20 to 40 deg at free-stream Reynolds numbers, based on the total orbiter scaled length, from 3.2 to 16.1 million. Typical heat-transfer data were

presented to illustrate boundary-layer transition locations and sensitivities to test variables. Author (GRA)

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N77-11099*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A SPECTRAL REFLECTANCE ESTIMATION TECHNIQUE USING MULTISPECTRAL DATA FROM THE VIKING LANDER CAMERA

Stephen K. Park and Friedrich O. Huck Washington Nov. 1976 44 p refs

(NASA-TN-D-8292; L-10681) Avail: NTIS HC A03/MF A01 CSCL 14B

A technique is formulated for constructing spectral reflectance curve estimates from multispectral data obtained with the Viking lander camera. The multispectral data are limited to six spectral channels in the wavelength range from 0.4 to 1.1 micrometers and most of these channels exhibit appreciable out-of-band response. The output of each channel is expressed as a linear (integral) function of the (known) solar irradiance, atmospheric transmittance, and camera spectral responsivity and the (unknown) spectral responsivity and the (unknown) spectral reflectance. This produces six equations which are used to determine the coefficients in a representation of the spectral reflectance as a linear combination of known basis functions. Natural cubic spline reflectance estimates are produced for a variety of materials that can be reasonably expected to occur on Mars. In each case the dominant reflectance features are accurately reproduced, but small period features are lost due to the limited number of channels. This technique may be a valuable aid in selecting the number of spectral channels and their responsivity shapes when designing a multispectral imaging system. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N77-11100*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPENSATED CONTROL LOOPS FOR A 30-cm ION THRUSTER

R. R. Robson 1976 17 p refs Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA

(NASA-TM-X-73497; E-8895) Avail: NTIS HC A02/MF A01 CSCL 21C

The vaporizer dynamic control characteristics of a 30-cm diameter mercury ion thruster were determined by operating the thruster in an open loop steady state mode and then introducing a small sinusoidal signal on the main, cathode, or neutralizer vaporizer current and observing the response of the beam current, discharge voltage, and neutralizer keeper voltage, respectively. This was done over a range of frequencies and operating conditions. From these data, Bode plots for gain and phase were made and mathematical models were obtained. The Bode plots and mathematical models were analyzed for stability and appropriate compensation networks determined. The compensated control loops were incorporated into a power processor and operated with a thruster. The time responses of the compensated loops to changes in set points and recovery from arc conditions are presented. Author

N77-11101*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LONG LIFETIME HOLLOW CATHODES FOR 30-cm MERCURY ION THRUSTERS

Michael J. Mirtich and William R. Kerslake 1976 22 p refs Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA

(NASA-TM-X-73523; E-8937) Avail: NTIS HC A02/MF A01 CSCL 21C

An experimental investigation of hollow cathodes for 30-cm Hg bombardment thrusters was carried out. Both main and neutralizer cathode configurations were tested with both rolled foil inserts coated with low work function material and impregnated porous tungsten inserts. Temperature measurements of an impregnated insert at various positions in the cathode were made. These, along with the cathode thermal profile are presented. A theory for rolled foil and impregnated insert operation and lifetime in hollow cathodes is developed. Several endurance tests, as long as 18000 hours at emission currents of up to 12 amps were attained with no degradation in performance. Author

N77-11102*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CYCLE LIFE TESTING OF 8-cm MERCURY ION THRUSTER CATHODES

Edwin G. Wintucky 1976 21 p refs Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA

(NASA-TM-X-73526; E-8942) Avail: NTIS HC A02/MF A01 CSCL 21C

Two main cathodes have successfully completed 2800 and 1980 cycles and three neutralizers, 3928, 3050, and 2850 cycles in ongoing cycle life tests of flight-type cathode-isolator-vaporizer and neutralizer-isolator-vaporizer assemblies for the 4.45 mN 8-cm Hg ion thruster system. Each cycle included one hour of cathode operation. Starting and operating conditions simulated those expected in a typical auxiliary propulsion mission duty cycle. The cycle life test results are presented along with results of an insert comparison test which led to the selection of a rolled foil insert type for the 8-cm Engineering Model Thruster cathodes. Author

N77-11103*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE DOCUMENTATION OF THE ENGINEERING MODEL 30-cm DIAMETER THRUSTER

Robert T. Bechtel and Vincent K. Rawlin 1976 35 p Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA

(NASA-TM-X-73530; E-8952) Avail: NTIS HC A03/MF A01 CSCL 21C

The results of extensive testing of two 30-cm ion thrusters which are virtually identical to the 900 series Engineering Model Thruster in an ongoing 15,000-hour life test are presented. Performance data for the nominal fullpower (2650 W) operating point; performance sensitivities to discharge voltage, discharge losses, accelerator voltage, and magnetic baffle current; and several power throttling techniques (maximum Isp, maximum thrust/power ratio, and two cases in between are included). Criteria for throttling are specified in terms of the screen power supply envelope, thruster operating limits, and control stability. In addition, reduced requirements for successful high voltage recycles are presented. Author

N77-11104*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SPUTTERING PHENOMENA OF DISCHARGE CHAMBER COMPONENTS IN A 30-cm DIAMETER Hg ION THRUSTER

Maris A. Mantenieks and Vincent K. Rawlin 1976 23 p refs Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov., 1976; sponsored by AIAA

(NASA-TM-X-73533; E-8957) Avail: NTIS HC A02/MF A01 CSCL 21C

Sputtering and deposition rates were measured for discharge chamber components of a 30-cm diameter mercury ion thruster. It was found that sputtering rates of the screen grid and cathode baffle were strongly affected by geometry of the baffle holder.

Sputtering rates of the baffle and screen grid were reduced to 80 and 125 A/hr, respectively, by combination of appropriate geometry and materials selections. Sputtering rates such as these are commensurate with thruster lifetimes of 15,000 hours or more. A semiempirical sputtering model showed good agreement with the measured values. Author

N77-11105*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH RELIABILITY CATHODE HEATERS FOR ION THRUSTERS
Lawrence A. Mueller 1976 16 p refs Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Florida, 15-17 Nov. 1976; sponsored by AIAA
(NASA-TM-X-73538; E-8966) Avail: NTIS HC A02/MF A01 CSCL 21C

A number of space missions were proposed which utilize 30-cm mercury bombardment ion thrusters and also require a large number of thruster restarts. A test program was carried out to determine thermal cycle life of several different cathode heater designs. Plasma/flame sprayed heaters and swaged type heaters were tested. Four of the five plasma/flame sprayed heaters tested failed in a comparatively short time. Four tantalum swaged heaters that were brazed to the tantalum cathode tube were successfully tested and met the goals that were set at the start of the test. Author

N77-11106*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRON BOMBARDMENT PROPULSION SYSTEM CHARACTERISTICS FOR LARGE SPACE SYSTEMS
D. C. Byers and V. K. Rawlin 1976 33 p refs Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA
(NASA-TM-X-73554; E-8992) Avail: NTIS HC A03/MF A01 CSCL 21C

The results of an anlaysis of electron bombardment ion propulsion systems for use in the transportation and on-orbit operations of large space systems are presented. Using baseline technology from the ongoing primary propulsion program and other sources, preliminary estimates of the expected characteristics of key system elements such as thrusters and propellant storage systems were performed. Projections of expected thruster performance on argon are presented based on identified constraints which limit the achievable thrust and/or power density of bombardment thrusters. System characteristics are then evaluated as a function of thruster diameter and specific impulse. Author

N77-11107*# McDonnell Aircraft Co., St. Louis, Mo.
GROUND TEST OF THE D SHAPED VENTED THRUST VECTORING NOZZLE
D. W. Esker 15 Oct. 1976 83 p refs
(Contract NAS2-8663)
(NASA-CR-137959; MDC-A4434) Avail: NTIS HC A05/MF A01 CSCL 21H

Static ground tests of a large scale lift/cruise thrust vectoring nozzle were conducted to establish: (1) vectoring performance 'in' and 'out' of ground effect; (2) thrust spoilage capability; (3) compatibility of the nozzle with a turbotip fan; and (4) the nozzle structural temperature distribution. Vectoring performance of a short coupled, vented nozzle design on a large scale, (60%) basis was compared with small scale (4.5%) test nozzle results. The test nozzle was a 'boilerplate' model of the MCAIR 'D' vented nozzle configured for operation with the LF336/J85 turbotip lift fan system. Calibration of the LF336/J85 test fan with a simple convergent nozzle was performed with four different nozzle exit areas to establish reference thrust, nozzle pressure ratio, and nozzle corrected flow characteristics for comparison with the thrust vectoring nozzle data. Thrust vectoring tests with the 'D' vented nozzle were conducted over the range of vector angles between 0 and 117 deg for several different nozzle exit areas. Author

N77-11108# Fairchild Space and Electronics Co., Germantown, Md.
NUCLEAR-POWERED HYSAT SPACECRAFT: COMPARATIVE DESIGN STUDY
B. Raab Aug. 1975 63 p
(Contract AT(49-15)-3063)
(ERDA-SNS-3063-8; FSEC-NSG-217-75/60) Avail: NTIS HC A04/MF A01

The study shows that the all nuclear spacecraft can have a substantial weight advantage over a hybrid (nuclear/solar) or all solar spacecraft, owing to a further reduction in power requirement, and to the elimination of such equipment as the sensor gimbal and rotating joint assemblies. Because the need for a sun-oriented section is eliminated, the all nuclear spacecraft can be designed as a monolithic structure, with the sensor and other payload firmly secured in a fixed position on the structure. This enhances attitude stability while minimizing structural weight and eliminating the need for flexible fluid lines. Sensor motion can be produced, varied, and controlled within the limits specified by the study contractors by moving the entire spacecraft in the prescribed pattern. A simple attitude control system using available hardware suffices to meet all requirements. ERA

N77-11109# Hercules, Inc., Wilmington, Del. Systems Group.
ANALYTICAL PREDICTION OF MOTOR COMPONENT VIBRATIONS DRIVEN BY ACOUSTIC COMBUSTION INSTABILITY Final Report, Aug. 1972 - Dec. 1975
F. R. Jensen Edwards AFB, Calif. AFRPL Feb. 1976 642 p
(Contract F04611-73-C-0025)
(AD-A025261; AFRPL-TR-76-11) Avail: NTIS HC A99/MF A01 CSCL 21/8

A detailed investigation has been conducted on the structural dynamic response of solid rocket motors. The study was particularly concerned with estimating the structural response to unstable acoustic combustion oscillations that often occur in solid motors during motor firing time. Detailed finite element analyses were performed on the Poseidon C-3 second stage motor and on the Minuteman III third stage motor using a NASTRAN computer program. In addition, the response of an inert second stage Poseidon C-3 motor to internal acoustic excitation was measured during an experimental task. A significant new analysis tool became available when the MacNeal-Schwendler Company incorporated the cyclic symmetry option into the NASTRAN frequency response rigid format using resources from this project. Results from the analyses were evaluated by comparing them with test data (from the inert Poseidon C-3 motor) and with actual firing data. Several special analyses were conducted on parts of the motor structure, such as separate grain or dome models, to better define expected overall motor response and to investigate possible modeling simplifications. Mechanical Impedance methods were used in the detailed motor analyses to account for components that are not symmetric about the motor centerline. Results from the AFRPL Component Vibration program that are given in the final report provide a considerable amount of detail on typical measured and predicted rocket motor response to acoustic combustion oscillations. Author (GRA)

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N77-11110 Rice Univ., Houston, Tex.
CHARGE AND MASS IDENTIFICATION OF FISSION FRAGMENTS Ph.D. Thesis
Theodore Harold Zabel 1976 193 p
Avail: Univ. Microfilms Order No. 76-21729

The detection of characteristic X-rays using a Si(Li) detector was investigated for the purpose of nuclear charge (Z) identification of fission fragments. The quantitative ambiguity due to K shell internal conversion demands that K shell vacancies be produced after nuclear excitation has relaxed. Inner-shell vacancies were produced by impact ionizations. The average X-ray yield for fragments stopping in a silicon surface barrier detector was measured to be 0.018 + or - 0.004 K X-rays per fragment. Similar studies using materials heavier than silicon showed a higher X-ray yield. A K X-ray Z spectrometer is proposed utilizing a germanium particle detector for X-ray production with

efficiency estimated as high as 18%. However, due to nuclear straggling effects, the heavy stopping materials necessary for efficient X-ray production cannot be used as a fission fragment energy detector for a time-of-flight mass measurement of 1 amu resolution. Dissert. Abstr.

N77-11111*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONFERENCE ON THE DEVELOPMENT OF FIRE-RESISTANT AIRCRAFT PASSENGER SEATS
Larry L. Fewell, Demetrius A. Kourtides, Robert W. Rosser, and John A. Parker Aug. 1976 130 p refs Conf. held at Moffett Field, Calif., 19 Mar. 1976
(NASA-TM-X-73144; A-6633) Avail: NTIS HC A07/MF A01 CSCL 06K

Papers are presented dealing with the development of aircraft seats with the minimum fire risk. Criteria examined include: flame spread, heat release, and smoke and/or toxic fumes. Materials and performance specifications of all seat material options are provided. Author

24 COMPOSITE MATERIALS

Includes laminates.

N77-11112 Virginia Polytechnic Inst., Blacksburg.
RATE AND TIME DEPENDENT BEHAVIOR OF STRUCTURAL ADHESIVES Ph.D. Thesis
Michael Peter Renieri 1976 214 p
Avail: Univ. Microfilms Order No. 76-23232

Two adhesives (Metlbond 1113 and 1113-2) identified as having applications in the bonding of composite materials are studied. The stress-strain behavior of the adhesives is shown to be significantly rate dependent. Further it is shown that a rate dependent stress-whitening (crazing) phenomenon occurs prior to the maximum stress. A region of elastic behavior, a rate and time dependent region, and a region of perfectly plastic flow are identified in the stress-strain behavior. A creep to failure phenomenon is shown to exist and is correlated with a delayed yield equation proposed by Crochet. Loading-unloading results are presented and are shown to correlate well with the proposed form of the loading-unloading equations for the modified Bingham model. Experimental results obtained for relaxation tests above and below the glass transition temperature are presented. It is shown that the adhesives obey the time-temperature superposition principle. Dissert. Abstr.

N77-11113 Virginia Polytechnic Inst. and State Univ., Blacksburg.
NONLINEAR ANALYSIS OF LAMINATED FIBROUS COMPOSITES Ph.D. Thesis
Gary Deno Renieri 1976 243 p
Avail: Univ. Microfilms Order No. 76-23231

A computerized analysis of the nonlinear behavior of fibrous composite laminates including axial loading, thermal loading, temperature dependent properties, and edge effects is presented. Ramberg-Osgood approximations are used to represent lamina stress-strain behavior and percent retention curves are employed to model the variation of properties with temperature. Balanced, symmetric laminates comprised of either born/epoxy, graphite/epoxy, or borsic/aluminum are analyzed using a quasi-three-dimensional finite element analysis. An incremental loading procedure is developed where the mechanical properties of each finite element may be adjusted depending on the temperature and/or the strain level. Results are presented for the interlaminar stress distributions in cross-ply, angle-ply, and more complex laminates. Elastic results for the boundary layer effect are shown to compare favorably with existing numerical solutions. Dissert. Abstr.

N77-11114*# IIT Research Inst., Chicago, Ill.
LAMINATION RESIDUAL STRESSES IN HYBRID COMPOSITES, PART 1 Final Report, 1 Jul. 1974 - 29 Feb. 1972
I. M. Daniel and T. Liber Jun. 1976 168 p refs
(Contract NAS3-16766)
(NASA-CR-135085; IITRI-D6073-2-Pt-1) Avail: NTIS HC A08/MF A01 CSCL 11D

An experimental investigation was conducted to study lamination residual stresses for various material and loading parameters. The effects of hybridization on residual stresses and residual properties after thermal cycling under load were determined in angle-ply graphite/Kevlar/epoxy and graphite/S-glass/epoxy laminates. Residual strains in the graphite plies are not appreciably affected by the type and number of hybridizing plies. Computed residual stresses at room temperature in the S-glass plies reach values up to seventy-five percent of the transverse strength of the material. Computed residual stresses in the graphite plies exceed the static strength by approximately ten percent. In the case of Kevlar plies, computed residual stresses far exceed the static strength indicating possible early failure of these plies. Static testing of the hybrids above indicates that failure is governed by the ultimate strain of the graphite plies. In thermally cycled hybrids, in general, residual moduli were somewhat lower and residual strengths were higher than initial values. Author

N77-11115*# IIT Research Inst., Chicago, Ill.
WAVE PROPAGATION IN FIBER COMPOSITE LAMINATES, PART 2 Final Report, 1 Jul. 1974 - 29 Feb. 1976
I. M. Daniel and T. Liber Jun. 1976 135 p refs
(Contract NAS3-16766)
(NASA-CR-135086; IITRI-D6073-3-Pt-2) Avail: NTIS HC A07/MF A01 CSCL 11D

An experimental investigation was conducted to determine the wave propagation characteristics, transient strains and residual properties in unidirectional and angle-ply boron/epoxy and graphite/epoxy laminates impacted with silicone rubber projectiles at velocities up to 250 MS-1. The predominant wave is flexural, propagating at different velocities in different directions. In general, measured wave velocities were higher than theoretically predicted values. The amplitude of the in-plane wave is less than ten percent of that of the flexural wave. Peak strains and strain rates in the transverse to the (outer) fiber direction are much higher than those in the direction of the fibers. The dynamics of impact were also studied with high speed photography. Author

N77-11116*# IIT Research Inst., Chicago, Ill.
STRAIN RATE EFFECTS ON MECHANICAL PROPERTIES OF FIBER COMPOSITES, PART 3 Final Report, 1 Jul. 1974 - 29 Feb. 1976
I. M. Daniel and T. Liber Jun. 1976 49 p refs
(Contract NAS3-16766)
(NASA-CR-135087; IITRI-D6073-4) Avail: NTIS HC A03/MF A01 CSCL 11D

An experimental investigation was conducted to determine the strain rate effects in fiber composites. Unidirectional composite specimens of boron/epoxy, graphite/epoxy, S-glass/epoxy and Kevlar/epoxy were tested to determine longitudinal, transverse and intralaminar (in-plane) shear properties. In the Longitudinal direction the Kevlar/epoxy shows a definite increase in both modulus and strength with strain rate. In the transverse direction, a general trend toward higher strength with strain rate is noticed. The intralaminar shear moduli and strengths of boron/epoxy and graphite/epoxy show a definite rise with strain rate. Author

N77-11117*# Scientific Translation Service, Santa Barbara, Calif.
CONTRIBUTIONS TO THE STUDY OF THE PHYSICAL PROPERTIES OF CARBON
F. Carmona Washington NASA Nov. 1976 193 p refs Transl. into ENGLISH of "Contributions a l'Etude des Proprietes Physiques des Carbons" Doctoral Dissertation, Bordeaux Univ., 1976 p 1-178
(Contract NASw-2791)
(NASA-TT-F-17246) Avail: NTIS HC A09/MF A01 CSCL 11D

A theoretical justification is given for old results of electron paramagnetic resonance. The evolution of the physical properties of carbon during carbonization is examined in light of recent theoretical and experimental studies on non-crystalline solids. Author

N77-11118*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF FIBER DIAMETER AND MATRIX ALLOYS ON IMPACT-RESISTANT BORON/ALUMINUM COMPOSITES

David L. McDanels and Robert A. Signorelli Washington Nov. 1976 38 p refs
(NASA-TN-D-8204; E-8648) Avail: NTIS HC A03/MF A01 CSCL 11D

Efforts to improve the impact resistance of B/A are reviewed and analyzed. Nonstandard thin-sheet charpy and Izod impact tests and standard full-size Charpy impact tests were conducted on composites containing unidirectional 0.10mm, 0.14mm, and 0.20mm diameter boron fibers in 1100, 2024, 5052, and 6061 Al matrices. Impact failure modes of B/Al are proposed in an attempt to describe the mechanisms involved and to provide insight for maximizing impact resistance. The impact strength of B/Al was significantly increased by proper selection of materials and processing. The use of a ductile matrix and large diameter boron fibers gave the highest impact strengths. This combination resulted in improved energy absorption through matrix shear deformation and multiple fiber breakage. , Author

N77-11119*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INTUMESCENT COATING CONTAINING 4,4'-DINITROSULFANILIDE Patent Application
Paul M. Sawko and Salvatore R. Riccitiello, inventors (to NASA) Filed 22 Oct. 1976 26 p
(NASA-Case-ARC-11042-1; US-Patent-Appl-SN-734902) Avail: NTIS HC A03/MF A01 CSCL 11D

A composition useful for insulating substrates from heat is described as an intumescent coating which contains 4,4 prime-dinitrosulfanilide as the intumescent agent. The principal constituents of the composition are the char or intumescent forming ingredient 4,4 prime-dinitrosulfanilide and a polymeric binder system comprising a chlorinated polyolefin, a bisphenol A epoxy resin and a rubber-like amine hardener. The intumescent composition can be applied by any satisfactory coating technique to a desired substrate by brushing, spraying, or the like. Once hardened, the coatings dry to tough adherent films with thicknesses preferably between 30 to 70 mils. When these coatings are heated or exposed to fire they expand or intumesce by a factor of 10 to 30 times the original coating thickness and form a tough, uniform, insulating char or residue which protects the substrate from heat or flames. The intumescent characteristics of the present composition are initiated at a temperature of about 200 deg C. The thermogravimetric analysis of the present invention, and a prior art intumescent agent are compared. The instant invention intumesces at a lower temperature than the prior art compound. The differential thermal analysis data show that the lower exothermic characteristic of the sulfanilide containing coating provides an overall improvement in the basic thermal protection afforded to substrates compared to other nitroaromatic amines. The present invention exhibits improved environmental stability and intumesces at favorable temperatures. NASA

N77-11120# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.
CRACK GROWTH DATA OF 2024-T3-CLAD AS DETERMINED IN FOKKER REPORT R-1764 AND IN NLR REPORT TN-M2092
A. H. LaCrois 12 Sep. 1974 27 p refs
(FOK-R-1814) Avail: NTIS HC A03/MF A01

Extensive investigations have been carried out on crack growth rate and fracture toughness valves of laminated structures. The results of two of these, one carried out by the National Aero and Astronautical Research Laboratory (NLR), the other by Fokker-VFW, are presented. Both investigations are discussed and results compared. In both experiments the stress ratio was found to be an important factor in relation to the crack growth rate. ESA

N77-11121# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.
CORROSION BEHAVIOUR OF MIXED LAMINATES (CFRP CORE WITH BOTH 7075-T6 CLAD AND 5052-H38 FACES)
A. Wielemaker 21 Apr. 1975 6 p refs
(FOK-R-1868) Avail: NTIS HC A02/MF A01

Salt spray tests were carried out on mixed laminate panels with both 0.1 mm thick 5052-H38 faces and 0.3 mm thick 7075-T6 clad faces, with carbon fiber reinforced plastic core, to determine the degree of attack by corrosion. It was found that mixed laminates made up with 7075-T6 clad aluminum alloys faces can be deteriorated rapidly by bondline corrosion when the edges are not properly sealed. When 5052-H38 aluminum alloy is used no risk for bondline corrosion was found; however, when the edges are not properly sealed the metal is slowly eaten away by corrosion. ESA

N77-11122# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.
CERTIFICATION OF THE REPLACEMENT OF GLASS FABRIC PER MAT. SPEC. 5.670/1, WITH GLASS FABRIC PER MAT. SPEC. 5.670 IN THE F27 PLASTIC SANDWICH WING-AND-STABILIZER-LEADING EDGES
L. M. Godfried 12 May 1975 11 p
(FOK-R-1876) Avail: NTIS HC A02/MF A01

The mechanical properties of sandwich constructions for F27 leading edges provided with faces of different glass fabric combinations were investigated. Three-point bending tests were carried out on sandwiches built up with glass fabric. No significant difference was found in mechanical strength and stiffness between the sandwiches tested. Author (ESA)

N77-11123# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.
COMPRESSIVE TEST METHOD FOR FIBER REINFORCED COMPOSITES
L. M. Godfried 12 May 1975 7 p ref
(FOK-R-1877) Avail: NTIS HC A02/MF A01

Two test methods for determination of the compressive properties of fiber reinforced polymeric resins were carried out and compared. They included axial compression tests on column type test specimens and tabbed bar specimens. Some significant observations on the effect of the specimen alignment in the measurement of compressive strengths of carbon fiber reinforced and glass fiber reinforced plastics are discussed. It was found that compressive strengths can be obtained which are significantly higher than those determined by column type specimens.
Author (ESA)

N77-11124# IIT Research Inst., Chicago, Ill.
THE EFFECTS OF MOISTURE ON THE MECHANICAL PERFORMANCE OF T300/GRAPHITE/GLASS/EPOXY HYBRID COMPOSITES Final Report, 1 Sep. 1974 - 30 Nov. 1975
K. E. Hofer, Jr. and L. C. Bennett Dec. 1975 195 p
(Contract N00019-75-C-0113)
(AD-A023668; IITRI-D6100-FR) Avail: NTIS HC A09/MF A01 CSCL 11/4

Thornel 300 Graphite/S-Glass Rovings/Narmco 5208 epoxy hybrid composites were investigated to establish the effect of temperature and moisture on the fatigue, impact and residual (after cycling) mechanical properties. GRA

N77-11125# Watervliet Arsenal, N.Y.
SIMPLE THICKNESS MODES AND SHEAR CORRECTION COEFFICIENTS FOR VISCOELASTIC TIMOSHENKO BEAMS
C. R. Thomas Apr. 1976 25 p refs
(AD-A023771; WVT-TR-76009) Avail: NTIS HC A02/MF A01 CSCL 11/4

A viscoelastic formulation of the Timoshenko beam theory is developed for viscoelastic constitutive equations in the form of the standard linear model. Viscoelastic shear correction coefficients are obtained by a direct comparison of simple thickness modes obtained from a viscoelastic continuum theory and from the approximate Timoshenko theory. GRA

N77-11126# IIT Research Inst., Chicago, Ill. Mechanics of Materials Research Div.
MECHANICAL PROPERTIES OF GLASS AND KEVLAR MOLDED COMPOSITES Final Report, 16 Jun. - 15 Nov. 1975
K. E. Hofer, Jr., W. Stepp, and R. H. Cornish Mar. 1976 123 p
(Contract DAAG46-75-C-0091; DA Proj. 1T1-62105-AH-84)
(AD-A024196; IITRI-D6111; AMMRC-CTR-76-7) Avail: NTIS

This present program was aimed at establishing those parameters prerequisite to a component processing and evaluation effort. The results of this program showed that the molding process is feasible for the preparation of advanced fiber reinforced plastic The results of this program showed that the molding process is feasible for the preparation of advanced fiber reinforced plastic components. Some of high stiffness characteristics inherent in Kevlar 49/epoxy materials are transferred from the continuous reinforcement composites to chopped fiber reinforced plastics. Thus the molded materials can provide the enhanced properties at reduced costs. Problem areas in the current molding process were demonstrated and numerous means for overcoming these problem areas within the current technology are discussed. GRA

N77-11127# Southwest Research Inst., San Antonio, Tex.
INVESTIGATION OF STRESS LEVELS CAUSING SIGNIFICANT DAMAGE IN COMPOSITES Final Report, 1 Aug. 1973 - 1 Nov. 1974
Glenn C. Grimes and P. H. Francis Jun. 1975 253 p refs
(Contract F33615-71-C-1574; AF Proj. 7340)
(AD-A024537; AFML-TR-75-33) Avail: NTIS HC A12/MF A01 CSCL 11/4

This program presents flat specimen and tube mechanical performance data on graphite/epoxy composites. The experimental program was designed to study significant damage stress levels in these materials. The objective of the investigation was to establish an experimental definition of the stress level within a composite specimen at which physical damage and/or degradation of mechanical properties are initiated such that the material resistance to subsequent loadings is seriously impaired. This stress level is referred to herein as the 'significant damage' stress level. In addition related experimental methods were developed and a laminate strength criterion was compared with the experimental data generated. Author (GRA)

N77-11128# General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.
ADVANCED HARDENED ANTENNA WINDOW MATERIALS STUDY 4 Final Report
James P. Brazel Feb. 1976 224 p refs
(Contract DAAG46-74-C-0140; DA Proj. 1W3-62306-AH-72)
(AD-A023944; AMMRC-CR-76-4) Avail: NTIS HC A10/MF A01 CSCL 09/5

The development and characterization of an improved ADL-4D6 silica/silica composite hardened antenna window material have been completed. A spall threshold in excess of 8000 taps for one inch thickness has been demonstrated, supported by determination of the dynamic equation of state. The design data level characterization program showed minimum room temperature tensile strengths of 5000 psi and nominal failure strain of 1%, with significantly higher measured values at temperatures up to 1600 F. GRA

N77-11129# Physics International Co., San Leandro, Calif.
CARBON-CARBON THERMAL STRUCTURAL RESPONSE TESTING Final Report
Kendall Childers, Vernon Buck, and James Shea Oct. 1975 106 p refs Sponsored in part by DNA, Washington, D.C.
(Contract F29601-74-C-0046)
(AD-A023919; PIFR-689; AFWL-TR-74-330) Avail: NTIS HC A06/MF A01 CSCL 11/4

An experimental program to obtain dynamic strain gauge measurements on 9-inch-diameter carbon-carbon rings in a pulsed electron beam environment was accomplished. Four AVCO 3DCC and four Sandia CVD felt rings were irradiated with peak front surface doses of 300 to 500 cal/g and with heating depths of 0.06 to 0.09 inch. Circumferential strain was measured as a function of time at six locations on the inside surface of the rings. GRA

N77-11130# California Univ., Los Angeles. School of Engineering and Applied Science.
PREPARATION AND PROPERTIES OF BETA-ALUMINA/GLASS COMPOSITES Final Report
John D. Mackenzie Jun. 1976 44 p refs Sponsored by EPRI
(PB-255549/8; EPRI-EM-181) Avail: NTIS HC A03/MF A01 CSCL 10C

Samples were prepared by hot pressing various ionically conducting glasses with beta-aluminum powders. The glassy phase served as a binder between the beta-alumina grains. Most of the binders, however, reacted with the beta-alumina and a new crystalline phase was formed. Altering the processing conditions either enhanced or reduced the amount of reaction and influenced the electrical properties accordingly. Additional experiments were performed in order to determine the transport mechanisms. It appears that transport in these composites is controlled by sodium ion migration through the beta-alumina. GRA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

N77-11131 Rice Univ., Houston, Tex.
LASER INDUCED FLUORESCENCE AS A SPECTROSCOPIC TOOL Ph.D. Thesis
Clifford Brown Bennett, Jr. 1976 147 p refs
Avail: Univ. Microfilms Order No. 76-21663

The use of laser induced fluorescence for the accurate determination of ground state vibrational constants and the determination of optical transition moments using saturation phenomena is reported. The fluorescence of C102 excited by the 4765 A line of the argon ion laser was studied. The fluorescence was observed as a progression in neutrino sub 1 and (neutrino sub 1 + neutrino sub 2) in 17 bands extending from 4800 A to 7500 A. The vibronic excitation was assigned along with two rotational excitations both giving rise to a series of doublets in the fluorescence bands. The ground state vibrational constants were accurately determined. Three saturation phenomena using lasers were investigated for possible use in optical transition moment determination: power broadening of saturation spectra; power dependence of fluorescence intensity; and power depolarization of fluorescence. Dissert. Abstr.

N77-11132 Houston Univ., Tex.
STEADY-STATE MULTIPLICITY OF CATALYTIC REACTION SYSTEMS Ph.D. Thesis
Gordon Ta-Hsiung Chen 1976 191 p
Avail: Univ. Microfilms Order No. 76-21860

The steady state behavioral features of lumped parameter systems in which two parallel first order chemical reactions occur are examined and classified. Sufficient conditions for uniqueness and multiplicity of the steady state solutions are derived. The occurrence of multiple solutions for two parallel endothermic reactions, and the existence of steady state multiplicity over an unbounded range of Damkohler number were found. The interaction between the chemical and transport processes can turn an undesired reaction, whose rate is negligible at the ambient conditions, into the controlling one. An experimental study of the steady-state multiplicity of an adiabatic packed-bed reactor is considered in which the atmospheric methanation of carbon monoxide on Ni/AL2O3 catalyst occurs. It was observed that multiple steady states exist over a wide range of feed temperature, concentration, and gas velocity. Dissert. Abstr.

N77-11133 Pennsylvania Univ., Philadelphia.
POLLUTANT FORMATION AND MULTIPLE STATIONARY STATES IN RADIANTLY STABILIZED FLAMES Ph.D. Thesis
Melvin Howard Bernstein 1976 405 p
Avail: Univ. Microfilms Order No. 76-22656

A premixed propane-air flame was stabilized in a refractory tube, with the necessary thermal feedback occurring by radiation from the hot downstream wall to the colder upstream wall and by conduction in the tube wall. The blowoff and flashback limits were determined and the temperature profile in the wall of a 3/8-inch tube was measured. The gas flow was turbulent under these conditions and the flames were steady, transparent and

essentially planar. The experiment consisted of three parts: (1) the reproducibility of the data was investigated; (2) the multiple stationary states predicted were sought and their computer model was studied; and (3) the reactor effluent was sampled, analyzed and modelled. The CO values were rationalized by computer studies as a combination of both kinetic and equilibrium effects. The NOX values were explainable on a purely kinetic basis. The results have practical importance as well as intrinsic interest in that the nitrogen oxide production is not only low for all conditions but also decreases significantly as the location of the stationary state shifts toward the exit of the combustion tube.

Dissert. Abstr.

N77-11134 Colorado Univ., Boulder.
DYNAMICS OF THE CONTINUOUS SETTLING OF DISCRETE-PARTICLE SLURRIES Ph.D. Thesis
Carlos J. Mijares-Lopez 1976 246 p
Avail: Univ. Microfilms Order No. 76-23654

A laboratory continuous settler was constructed with the objective of verifying the applicability of a theoretical unsteady-state mathematical model developed to describe the dynamic behavior of the continuous settling operation. In the model, a circular settler was divided into three vertical zones: (1) the section above the feed, (2) the section below the feed of constant cross sectional area, and (3) the section of decreasing cross sectional area at the bottom of the settler. The equations describing each of these sections were somewhat different and each was represented by one or more mixed tanks in series. Discrete particle slurries were used which, with their unique settling characteristics and solids flux curves, imposed theoretical and operational limitations on the continuous settling runs. Batch studies were conducted on both an ion-exchange resin slurry and a fine-glass-beads slurry. Author

N77-11135 Houston Univ., Tex.
REMOTE SENSING OF TEMPERATURE AND COMPOSITION OF GAS PLUMES BY INFRARED EMISSION INTERFEROMETRY-SPECTROSCOPY Ph.D. Thesis
Uday Mahagaokar 1976 525 p
Avail: Univ. Microfilms Order No. 76-21863

Quantitative aspects of the technique of remote sensing of stationary sources by infrared emission spectroscopy were studied. A method is developed for independently determining the temperature and composition of the remote gas plume from data collected with a rapid scan interferometer-spectrometer system. The analysis accounts for atmospheric attenuation caused mainly by CO2 and H2O and background radiation originating from various sources in the background of the plume. The background radiation factor has been semiempirically correlated for application to transparent and opaque targets. Measurements were made, using the above technique, to observe temperature gradients and fluctuations in an emerging plume in a generally calm atmosphere. The axial profile data indicated a decay in the mean plume temperature from 507 K at the source to 425 K within three meters downstream from the source.

Dissert. Abstr.

N77-11136*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ABSOLUTE RATE OF THE REACTION OF C L(2P) WITH METHANE FROM 200-500 K
D. A. Whytock (Essex Univ., Colchester, England), J. H. Lee, J. V. Michael, W. A. Payne, and L. J. Stief Oct. 1976 25 p refs Submitted for publication
(NASA-TM-X-71221; X-691-76-40) Avail: NTIS HC A02/MF A01 CSCL 07D

Rate constants for the reaction of atomic chlorine with methane have been measured from 200-500K using the flash photolysis-resonance fluorescence technique. When the results from fourteen equally spaced experimental determinations are plotted in Arrhenius form a definite curvature is noted. The results are compared to previous work and are theoretically discussed.

Author

N77-11137# Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
AUTOMATED WAVELENGTH SELECTION FOR FLAME SPECTROSCOPY
M. Hurteau, J. P. Mislan, and R. W. Ashley Jan. 1976 16 p refs
(AECL-5311) Avail: ERDA Depository Libraries HC $3.50; AECL $2.00

A simple electro-mechanical programming system is described for use with a flame spectrophotometer. Its application for automated sequential multi-element analysis is illustrated. Reproducibility of wavelength settings is within + or - 0.5 A. Precision and sensitivities are at least as good as those obtained for single element determinations. ERA

N77-11138*# Arizona Univ., Tucson. Dept. of Physics.
FUTURE DIRECTIONS FOR BEAM-FOIL SPECTROSCOPY
S. Bashkin Jan. 1976 19 p refs Sponsored in part by NASA and NSF
(Contract N00014-75-C-0499)
(NASA-CR-149177; AD-A024147) Avail: NTIS HC A02/MF A01 CSCL 14/2

The beam-foil source has proved to be so useful for the study of atomic energy levels that it is almost trivial to propose a variety of new experiments involving new elements, higher energies, a broader wavelength range, shorter time intervals, pulsed beams, different targets, and new configurations in geometry or external fields. However, what is perhaps not so trivial is to propose experiments for which there is a specific purpose, experiments from which a novel kind of information might be expected. It is from this latter point of view that the author shall talk about experiments which seem to offer unusual opportunities to learn new things about atoms. GRA

N77-11139# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
COMMENT ON A PARADOX: THE THERMAL RATE COEFFICIENT FOR THE H + DCI YIELDS HCI + D EXCHANGE REACTION
R. F. Heidner, III and Jerry F. Bott Apr. 1976 13 p refs
(Contract F04701-75-C-0076)
(AD-A023896; TR-0076(6603)-9; SAMSO-TR-76-78) Avail: NTIS HC A02/MF A01 CSCL 07/4

Experimental data are presented that show that chlorine atom abstraction from HCl by a colliding D or H atom is relatively slow at room temperature. These slow rates are much smaller than those obtained by trajectory calculations, suggesting that the activation energy for this process is greater than 3 kcal/mol. Author (GRA)

N77-11140# Computer Genetics Corp., Wakefield, Mass.
DEVELOPMENT OF A RAMAN SYSTEM AS A COMBUSTION DIAGNOSTIC TOOL Final Technical Report, Mar. - Sep. 1975
D. A. Leonard and Bernard Caputo Oct. 1975 41 p refs
(Contract F33615-75-C-2023; AF Proj. 3048)
(AD-A023935; AFAPL-TR-75-99) Avail: NTIS HC A03/MF A01 CSCL 07/4

This report presents the results of a study and experimental program undertaken to investigate the utilization of a laser Raman system in combustion research and engineering. The study discusses the possible instrument configurations that could be employed to produce an effective laboratory tool for combustion diagnostics. Test results are presented which show the operating characteristics of a modified pulsed nitrogen laser Raman system probing the exhaust of a T56 combustor rig operating under maximum power conditions. During the testing, N2, O2 and CO2 species were detected, the level of laser induced fluorescence background and its RMS fluctuation was determined and 'hot-band' spectra of nitrogen suitable for use in temperature measurements was obtained. Author (GRA)

N77-11141# Hebrew Univ., Jerusalem (Israel).
ENERGY TRANSFER BETWEEN INORGANIC IONS IN GLASSES Final Report, Nov. 1974 - Nov. 1975
Renata Reisfeld Nov. 1975 39 p refs
(Grant DA-ERO-75-G-029; DA Proj. DO1-61102-BB-349)
(AD-A023910; R-2183) Avail: NTIS HC A03/MF A01 CSCL 07/4

Contents: Optical properties of bismuth in germanate, borax and phosphate glasses; The determination of the nephelauxetic effect in oxide glasses by Sn(2+), Sb(3+), Tl(+), Pb(2+) and

Bi(3+) ions; Variation of fluorescence intensities and lifetime of Sm(3+) and Tb(3+) with As2O3 content in arsenic and borax glasses; Multiphonon relaxation of rare earth ions in borate, phosphate, germanate and tellurite glasses; Optical intensities of holmium in tellurite, calibo and phosphate glasses; Quantum yield of Ce(3+) and energy transfer between Ce(3+) and Tb(3+) in borax glasses; Energy transfer between Pb(2+) and Eu(3+) in germanate glass; Energy transfer from Ce(3+) to Tm(3+) in borate and phosphate glasses; Energy transfer between Bi(3+) to Eu(3+), Bi(3+) to Sm(3+) and UO2(2+) yield Eu(3+) in oxide glasses; Properties of rare earth doped inorganic glasses as related to their lasing abilities. GRA

N77-11142# Naval Medical School, Bethesda, Md.
THE INTERNATIONAL CONFERENCE ON COLLOID AND SURFACE SCIENCE (IUPAC)
A. L. Powell Mar. 1976 8 p refs Conf. held at Budapest, Hungary, 15-20 Sep. 1975
(AD-A024159; ONRL-C-9-76) Avail: NTIS HC A02/MF A01 CSCL 07/4

This report covers contributions made at an IUPAC-sponsored conference on colloid and surface science convened in Budapest, Hungary, during the period of 15-20 September 1975. Papers at the meeting covered a wide range of theoretical and experimental approaches to research in colloid and surface science. A number of plenary and main lectures were offered, most of which were of a review nature and set the tone for the conference. The meeting also provided a forum for scientists from the East and West to meet informally and exchange research information. Author (GRA)

N77-11234# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LASER RAMAN DIAGNOSTICS OF AERODYNAMIC FLOWS AND FLAMES
Sylvie Druet, Robert Bailly, Michel Pealat, and Jean-Pierre Taran *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 12 p refs In FRENCH; ENGLISH summary (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11246# National Gas Turbine Establishment, Pyestock (England).
INVESTIGATION OF A V-GUTTER STABILIZED FLAME BY LASER ANEMOMETRY AND SCHLIEREN PHOTOGRAPHY
H. Clare, D. F. G. Durao (Imperial College, London), A. Melling (Imperial College, London), and J. H. Whitelaw (Imperial College, London) *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 10 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N77-11143 George Washington Univ., Washington, D.C.
A THEORY OF ION SPUTTERING Ph.D. Thesis
Harris Gordon Prival 1976 186 p
Avail: Univ. Microfilms Order No. 76-21766

Based on some of the notable shortcomings of previous ion sputtering theories, on the results of experiments performed to establish some of the factors on which ion sputtering depends, and on the work of earlier workers, a new theory of ion sputtering from metals and semimetals is proposed. According to this theory: (1) Sputtered atoms or ions originate almost entirely from the surface layer. (2) Atoms initially leave the surface in the same charge state in which they exist in the crystal, and are largely neutralized in traversing a region near the surface. (3) Neutralization can be explained in terms of quantum mechanical electron transmission and reflection phenomena that occur when the atom is within about three spacings from the surface. (4) Neutralization occurs with quite high efficiency. Only between 0.01 and 0.000001 of the emitted atoms survive neutralization.
Dissert. Abstr.

N77-11144 Syracuse Univ., N.Y.
DIFFUSION IN TRANSITION METALS AND ALLOYS AND SELECTIVE ADSORPTION AND HYDROGEN EMBRITTLEMENT Ph.D. Thesis
Venkataraman Srikrishnan 1975 103 p
Avail: Univ. Microfilms Order No. 76-18563

The activation energies for diffusion in transition metals is correlated against the localized d electron population. The d electron population is determined by the Engel-Brewer theory. A quasi-chemical model of a binary solid solution is used to determine the distribution of atoms and vacancies. The use of this model enables one to determine the average number of bonds affected by the formation of a vacancy and the jumping of an atom into the vacancy. The calculated activation energies of impurity atoms in pure metals and of self diffusion in binary alloys (Co-Ni, Fe-Ti, Fe-Cr, and Fe-V) are compared with experimental results. The effects of the presence of gaseous additives (SO2, O2, CO2, N2O, and H2S) on hydrogen adsorption was studied with an iron foil. The results of the adsorption experiments are correlated with experimental observations on the crack growth of 4340 steel in a hydrogen gas environment. Explanations are proposed for the inhibiting or promoting effects of the gaseous additives on the crack propagation in steel.
Dissert. Abstr.

N77-11145 Virginia Univ., Charlottesville.
THE OXIDATION OF T-111 ALLOY AT HIGH TERMPERATURES AND LOW PRESSURES Ph.D. Thesis
Richard John Mitchell 1976 273 p
Avail: Univ. Microfilms Order No. 76-22844

The T-111 (Ta + 8 at. % W + 2 at. % Hf) alloy was oxidized at 850 C, 900 C, 950 C and 1000 C. At each temperature, oxidations were performed at 0.0003 Torr, 0.0001 torr and 0.0005 torr. Surface features were observed in situ in a vacuum hot stage optical microscope. Oxidized samples were weighted to determine oxygen intake and were examined by SEM, TEM, HEED, and X-ray diffraction. Dissert. Abstr.

N77-11146 Pennsylvania Univ., Philadelphia.
ELECTROLYTIC HYDROGEN IN BETA TITANIUM Ph.D. Thesis
John Jerry DeLuccia 1976 211 p
Avail: Univ. Microfilms Order No. 76-26679

The permeation of electrolytic hydrogen through beta titanium foils with oxide free, palladium coated surfaces, was undertaken. The alloy chosen for study was Ti - 11.5 Mo - 6 Zr - 4.5 Sn in the solution treated and quenched condition. The vacuum processes of ion bombardment etching followed by thin film vapor deposition of palladium were employed to produce oxide free titanium specimens suitable for electro chemical hydrogen permeation and embrittlement studies. In the electrochemical method of hydrogen permeation, a thin metallic foil was cathodically charged with hydrogen on one side while the other side was maintained at a sufficiently anodic potential so that all the hydrogen which diffuses through is oxidized and turned into an equivalent current. Thus a source and sink for electrolytic hydrogen exist at opposite sides of the metallic specimen. The amplified and recorded current was analyzed to provide diffusivity and solubility data of hydrogen in the alloy. X-ray diffraction methods were employed to determine the effects of hydrogen on the lattice parameter of the beta titanium alloy.
Dissert. Abstr.

N77-11147 Clark Univ., Worcester, Mass.
INVESTIGATION OF CRITICAL PHENOMENA IN NICKEL THROUGH PERTURBED ANGULAR CORRELATION EXPERIMENTS Ph.D. Thesis
Thomas Anthony Kachnowski 1976 108 p
Avail: Univ. Microfilms Order No. 76-22585

Static and dynamic critical phenomena in nickel is measured using the method of perturbed angular correlations (PAC). The critical exponent beta is measured using dilute Cd-100 to probe the hyperfine field. The result is in good agreement with other hyperfine measurements with dilute impurity probes as well as bulk measurements, and with epsilon-expansion results for the Heisenberg model. Very low magnetic fields were applied and dilute Rh-100 was used to obtain the first measurement by PAC of the exponent gamma. The result differs significantly from

the best high temperature series and epsilon-expansion estimate for the isotropic Heisenberg model. Experimental methods and data analysis techniques are discussed. Evidence for the probe independence of measured exponents is reviewed. Dissert. Abstr.

N77-11148 Drexel Univ., Philadelphia, Pa.
PREVENTION OF DEFECTS IN POWDER PREFORM FORGING Ph.D. Thesis
Sang Kee Suh 1976 226 p
Avail: Univ. Microfilms Order No. 76-22414

Ductile fracture is a common problem in deformation processing of material and is particularly critical during forming of P/M preforms due to the inherent low ductility of sintered material. Forming of an axisymmetric part consisting of a hub and flange provides a convenient device for study of all types of fracture. Sintered 601 AB aluminum powder billets having 80% theoretical density were utilized to simulate hot deformation of 4620 steel powder preforms. The effect of process variables (e.g., draft angle, friction condition, die corner radius, part dimension and preform shape) on each type of fracture was investigated experimentally. Plasticity theory was also used in analyzing some aspects of the plastic deformation of powder preforms. Each process variable showed different effects on the three types of fracture. Guidelines are formulated for preform and process design for manufacturing defect-free parts.
Dissert. Abstr.

N77-11149 Illinois Inst. of Tech., Chicago.
EMBRITTLEMENT OF CARBON STEELS AND IRON BY INDIUM Ph.D. Thesis
Francis Alexander Shunk 1976 158 p
Avail: Univ. Microfilms Order No. 76-23501

The relationship between level, microstructure, and metallic embrittlement (LME) of carbon steels and iron by indium was investigated. The embrittlement of spheroidized 1095 steel which was quenched and tempered to obtain four different strength levels was determined from fracture stresses and reduction of area data. Corresponding data were obtained for a spheroidized 1040 steel, high purity iron, and a lamellar 1095 steel. The mean free ferrite path was determined for each of these materials. A model of the fracture process which incorporates a surface crack initiation mechanism and competitive interplay between surface crack propagation and normal fracture processes is proposed to account for the results. The dispersion and morphology of second phase particles affect both the initiation and propagation aspects of fracture in metallic embrittlement. Dissert. Abstr.

N77-11150 Rice Univ., Houston, Tex.
ON THE KINETICS AND THERMODYNAMICS OF METALLIC SOLID SOLUTIONS Ph.D. Thesis
Daniel Craig Parris 1976 56 p
Avail: Univ. Microfilms Order No. 76-21702

The diffusivity of carbon in face centered cubic iron and in nickel at 1000 C as a function of concentration in the absence of a concentration gradient has been measured. A statistical mechanical solution model has been applied to the result and the variance from the finite gradient diffusivities has thereby been explained. A statistical mechanical cumulant expansion technique has been applied to substitutional metallic solid solutions exhibiting complete solid solubility. Comparisons were carried out between thermodynamic quantities predicted by the theory and those found by experiment. The theory was shown to be of limited utility in predicting the thermodynamics of such solutions. Dissert. Abstr.

N77-11151 Rice Univ., Houston, Tex.
STUDIES OF THE KINETICS OF ENVIRONMENTAL HYDROGEN EMBRITTLEMENT IN TITANIUM ALLOYS Ph.D. Thesis
Harold Walter Levio 1976 97 p
Avail: Univ. Microfilms Order No. 76-21689

An apparatus was developed to allow the fracture kinetics of environmental hydrogen embrittlement of titanium alloys to be studied under conditions of extreme purity. Fracture propagation rates were measured for Ti-6Al-4V as a function of hydrogen pressure, utilizing a double cantilever beam specimen and alloy having beta grains in a continuous alpha-titanium matrix. Fracture rates were found to be proportional to the square root of the hydrogen pressure. Under the same conditions, specimens of pure alpha-titanium were immune to the effects of the hydrogen environment. Clean fracture surfaces of beta-phase Ti-13V-11Cr-5Al were found to absorb hydrogen rapidly, but propagating fractures were not observed. Spontaneous catastrophic hydriding of this alloy was found to be possible at room temperature.
Dissert. Abstr.

N77-11152 Lehigh Univ., Bethlehem, Pa.
STUDY OF VARIABLES AFFECTING LAMELLAR TEARING SUSCEPTIBILITY OF STEELS Ph.D. Thesis
Swaminathan Ganesh 1976 148 p
Avail: Univ. Microfilms Order No. 76-21810

Lamellar tearing was observed to occur in three distinct stages, viz: void formation, void growth and void linkage, with the total energy for tearing dependent on the energy expended in each stage. The energy for void formation was observed to be a function of the type, size and spacing of inclusions with the silicates being more harmful than the sulfides, as they tended to shatter at lower strains whereas the sulfides generally decohered. The larger inclusions formed voids earlier than the smaller ones due, possibly to their containing more flaws, suggesting that significant improvements can be sought by controlling the inclusion size and shape, without having to reduce its volume fraction. Terrace linkage of adjacent voids occurred by several modes such as necking, microvoid coalescense, zig-zag tearing, intergranular cracking, quasi-cleavage, cleavage, etc. The shear linkage of terrace tears occurred late in the tearing process and preceded unstable propagation. Dissert. Abstr.

N77-11153 Cincinnati Univ., Ohio.
EFFECT OF MICROSTRUCTURE ON THE FATIGUE CRACK GROWTH OF A POWDER METALLURGY NICKEL-BASE SUPERALLOY Ph.D. Thesis
Jon Lee Bartos 1976 195 p
Avail: Univ. Microfilms Order No. 76-23256

Fatigue crack propagation (FCP) studies were conducted at 538 C on a nickel base superalloy, Rene' 95, prepared by powder metallurgy techniques to investigate the effects of microstructural parameters on FCP behavior. Specimens were prepared to evaluate the effect of grain size and second phase particle size on crack growth rate, da/dN. Two grain sizes, 5 to 10 micrometers and 30 to 50 micrometers, and five second phase particle sizes, 0.08, 0.1, 0.2, 0.3, ans 0.5 micrometers were evaluated. Results of FCP tests, fractorgraphic, and transmission electron microscopic evaluations indicated both grain and second phase particle size have a significant effect on da/dN. Grain size has a substantial effect on preferred crack propagation mode while second phase particle size controls the strain hardening capacity of the material. Crack propagation rates decrease with decreasing second phase particle size in materials exhibiting transgranular fracture.
Dissert. Abstr.

N77-11154*# Pratt and Whitney Aircraft, East Hartford, Conn.
REFINEMENT OF PROMISING COATING COMPOSITIONS FOR DIRECTIONALLY CAST EUTECTICS
T. E. Strangman, E. J. Felten, and R. S. Benden Oct. 1976 156 p refs
(Contract NAS3-18920)
(NASA-CR-135103; PWA-5441) Avail: NTIS HC A08/MF A01 CSCL 11C

The successful application of high creep strength, directionally solidified gamma/gamma prime-delta (Ni-19.7Cb-6Cr-2.5Al) eutectic superalloy turbine blades requires the development of suitable coatings for airfoil, root and internal blade surfaces. In order to improve coatings for the gamma/gamma prime-delta alloy, the current investigation had the goals of (1) refining promising coating compositions for directionally solidified eutectics, (2) evaluating the effects of coating/ substrate interactions on the mechanical properties of the alloy, and (3) evaluating diffusion aluminide coatings for internal surfaces. Burner rig cyclic oxidation, furnace cyclic hot corrosion, ductility, and thermal fatigue tests indicated that NiCrAlY+Pt(63 to 127 micron Ni-18Cr-12Al-0.3Y + 6 micron Pt) and NiCrAlY(63 to 127 micron Ni-18Cr-12Al-0.3Y) coatings are capable of protecting high temperature gas path surfaces of eutectic alloy airfoils. Burner rig (Mach 0.37) testing indicated that the useful coating life of the 127 micron thick coatings exceeded 1000 hours at 1366 K

(2000 deg F). Isothermal fatigue and furnance hot corrosion tests indicated that 63 micron NiCrAlY, NiCrAlY + Pt and platinum modified diffusion aluminide (Pt + Al) coating systems are capable of protecting the relatively cooler surfaces of the blade root. Finally, a gas phase coating process was evaluated for diffusion aluminizing internal surfaces and cooling holes of air-cooled gamma/gamma prime-delta turbine blades. Author

N77-11155*# National Aeronautics and Space Administration. Lewis Research Center., Cleveland, Ohio.
HOT HARDNESS OF NICKEL-RICH NICKEL-CHROMIUM-ALUMINUM ALLOYS
Stanley R. Levine Washington Oct. 1976 18 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Cleveland, Ohio
(NASA-TM-X-3429; E-8750) Avail: NTIS HC A02/MF A01 CSCL 11F

Rockwell A hardness of cast nickel-chromium-aluminum (NiCrAl) alloys was examined from ambient to 1150 K and compared to cast NiAl and IN-100. Alloy constitution was either gamma, gamma prime + gamma or gamma + beta + alpha + gamma prime. Below 1000 K beta containing NiCrAl alloys have hardnesses comparable to IN-100; above 1000 K they soften faster than IN-100. At 1150 K the hardness of beta-containing NiCrAl alloys decreases with increasing beta-content. The beta-containing NiCrAl alloys were harder than beta-NiAl. The ultimate tensile strengths of the NiCrAl alloys were estimated. The effects of NiCrAl coatings on strength and fatigue life of cooled turbine components were deduced. Author

N77-11156# Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
SUSCEPTIBILITY OF COLD-WORKED ZIRCONIUM-2.5 WT. PERCENT NIOBIUM ALLOY TO DELAYED HYDROGEN CRACKING
C. E. Coleman Jan. 1976 28 p
(AECL-5260) Avail: ERDA Depository Libraries HC $4.00; AECL $3.00

Notched tensile specimens of cold-worked zirconium--2.5 wt. percent niobium alloy were stressed at 350 and 520 K. At 350 K, above a possible threshold stress of 200 MPa, specimens exhibited delayed failure which was attributed to hydride cracking. Metallography showed that hydrides accumulated at notches and tips of growing cracks. The time to failure appeared to be independent of hydrogen content over the range 7 to 100 ppM hydrogen. Crack growth rates of about 10 to the -10th power m/s deduced from fractography were in the same range as those necessary to fracture pressure tubes. The asymptotic stress intensity for delayed failure, K/sub 1H/, appeared to be about 5 MPa square root/m. With this low value of K/sub 1H/ small surface flaws may propagate in pressure tubes which contain large residual stresses. Stress relieving and modified rolling procedures reduce the residual stresses to such an extent that only flaws 12 percent of the wall thickness or greater grow. At 520 K no failures were observed at times a factor of three greater than times to failure at 350 K. Zirconium--2.5 wt. percent niobium appears to be safe from delayed hydrogen cracking at the reactor operating temperature. ERA

N77-11157# California Univ., Berkeley. Lawrence Berkeley Lab.
UTILIZATION AND LIMITATIONS OF PHASE TRANSFORMATIONS AND MICROSTRUCTURES IN ALLOY DESIGN FOR STRENGTH AND TOUGHNESS
Gareth Thomas Sep. 1975 48 p refs Presented at Colloq. on Fundamental Aspects of Structural Alloy Design, Richland, Wash., 15 Sep. 1975
(Contract W-7405-eng-48)
(LBL-4175; Conf-7509116-1) Avail: NTIS HC A03/MF A01

The development and characterization of microstructures resulting from phase transformations, in martensitic steels and spinodal systems, are outlined and discussed in relation to improvements in ambient temperature strength and toughness. Spinodals and martensites can both have dislocated fine grained microstructures when formed under appropriate conditions. In martensitic steels the importance of retained austenite morphology and stability on toughness at high strengths is emphasized. A method is described for improving the strength of low carbon steels by developing duplex fine grained structures of ferrite and martensite. It is suggested that coarsened spinodal alloys have good work hardening strengthening potential, if the discontinuous growth problem at grain boundaries can be overcome. Some ideas for the utilization of multiple phase transformations are also presented. Author (ERA)

N77-11158# Oxford Univ. (England). Engineering Lab.
METALHYDRIDES
A. J. W. Horrox 1976 11 p refs
(OUEL-1146/76) Avail: NTIS HC A02/MF A01

The first phase of research work carried out at Battelle, Geneva, on metal hydrides is presented. The project is sponsored by 20 companies in Europe and Japan. As a result of the studies Battelle believes to have found the alloy in which the necessary conditions, reversibility of hydride formation under favorable conditions, hydrogen storage capacity, maximum number of recycling operations possible, and cost, are optimized. Systems studied include magnesium, iron/titanium, lithium aluminum hydride, and lanthanum/nickel. ESA

N77-11159# California Univ., San Diego. Dept. of Physics.
POLARIZATION INDUCED SURFACE DIPOLE MOMENTS
E. Zaremba Apr. 1976 11 p refs
(Contract N00014-76-C-0050; NR Proj. 017-653)
(AD-A024387; TR-34) Avail: NTIS HC A02/MF A01 CSCL 07/4

The work of Antoniewicz on the polarization induced surface dipole moment of a metal-atom system is generalized to include the retarded response of the metallic electrons. GRA

N77-11160# Pratt and Whitney Aircraft, East Hartford, Conn.
HOT CORROSION OF COBALT-BASE ALLOYS Final Technical Report, 1 Jun. 1972 - 31 May 1975
J. A. Goebel and F. S. Pettit Jun. 1975 191 p refs
(Contract F33615-72-C-1757; AF Proj. 7021)
(AD-A024425; PWA-5379; ARL-TR-75-0235) Avail: NTIS HC A09/MF A01 CSCL 11/6

The sodium sulfate-induced hot corrosion of cobalt and a number of binary, ternary and quaternary cobalt-based alloys containing aluminum, chromium, tungsten, molybdenum, tantalum, titanium and yttrium has been studied at 1000-degrees Celsius in 1 atm of oxygen or air. The studies consisted of both laboratory experiments and testing with a dynamic burner rig. The results obtained from these studies were compared to those available for equivalent nickel-base systems. Those obtained from laboratory tests were in satisfactory agreement with those from dynamic burner rigs except that the loss of chromium from the alloys was more pronounced in the high velocity rig tests. It was determined that sodium sulfate deposits caused increased oxidation of all of the alloys studied. Mechanisms for the hot corrosion of these alloys have been developed. A substantial difference between the hot corrosion resistance of cobalt- and nickel base alloys has been observed only for alloys containing chromium and aluminum with no refractory elements. Chromium and yttrium produced beneficial effects on the hot corrosion of alloys; aluminum also produced beneficial effects except at low concentrations of aluminum. Molybdenum and tungsten usually produced deleterious effects on the hot corrosion of alloys whereas tantalum and titanium were apparently innocuous. Author (GRA)

N77-11161# Cincinnati Univ., Ohio. Dept. of Materials Science and Metallurgical Engineering.
BASIC MECHANISMS PROVIDING OXIDATION RESISTANCE IN STRUCTURAL METALS AT HIGH TEMPERATURES. VOLUME 2: THE DEFECT STRUCTURE OF NONSTOICHIOMETRIC RUTILE (Ti 02) AND NONSTOICHIOMETRIC RUTILE CONTAINING 1 TO 10 MOLE PERCENT Cb205 Final Report, 21 Dec. 1973 - 20 Dec. 1974
Casimir J. Rosa Aug. 1975 164 p refs
(Contract N62269-74-C-0300)
(AD-A024540; NASC-0300-5-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 11/6

The overall research program in which this investigation is a part is a study of oxidation of titanium and titanium alloys in hopes of yielding information concerning possible alloy additions which may improve the oxidation resistance of titanium structural materials at temperatures in the range 800 to 1200C. Previous

investigations have shown marked improvement in the oxidation resistance of titanium by additions of several metals, of which columbium is one. Because the thermodynamic stability limits for nonstoichiometric rutile is in the range of oxygen chemical potentials which can be conveniently measured by electrochemical techniques, an EMF (electromotive force) cell using yttria doped thoria as a solid electrolyte was designed to determine the thermodynamic properties of nonstoichiometric rutile and rutile containing columbia. GRA

N77-11162# Battelle Columbus Labs., Ohio.
DIRECTIONALLY SOLIDIFIED IN SITU METAL MATRIX COMPOSITES, PART 1 Final Report, 1 Nov. 1974 - 1 Jan. 1976
G. Haour, F. Mollard, B. Lux, A. H. Clauer, and I. G. Wright Jan. 1976 61 p refs
(Contract N00019-74-C-0409)
(AD-A024217) Avail: NTIS HC A04/MF A01 CSCL 11/6

The aim of the present alloy screening program was to identify new eutectic superalloys suitable for the manufacture of directionally solidified turbine blades operating at up to 1150 C. In the course of this program, five eutectics not previously investigated have been found to meet the corresponding objectives of a melting point above 1200 C, a specific gravity below 9 g/cc and a reasonably low oxidation rate. The properties are comparable to those of the presently most advanced eutectic superalloys, such as Ni-2.5A1-19.7Nb-6Cr or Co20TaC-15Cr--8.5Ni-6W. Their oxidation rates, already comparable to that of Co-TaC, measured in the present study, could be further improved by compositional adjustments. These results were obtained on the basis of a screening of available phase diagrams for 107 alloy systems based on Ni, Co and Fe, from which 52 alloy systems were retained for further study. Twenty-eight simple ternary systems, either not previously evaluated or not described in sufficient detail, were examined experimentally by preparing several samples of compositions close to that determined by a semi-empirical graphical method as closest to the expected eutectic. As a result, 22 eutectics were identified and characterized in terms of melting temperature, microstructure and estimated density. Of these, 10 eutectics were found to meet the objectives of a melting point above 1200 C, a 'regular' microstructure presumably amenable to directional solidification and a density below 9 g/cc. They were therefore subjected to a systematic investigation of their oxidation resistance, leading to the identification of the 5 promising eutectics previously mentioned. GRA

N77-11163# California Univ., Los Angeles. Dept. of Materials.
STRAIN ENERGY CRITERION OF MARTENSITIC TRANSFORMATION
M. Shibata and Kanji Ono Apr. 1976 10 p refs
(Contract N00014-75-C-0889; NR Proj. 031-781)
(AD-A023781; TR-2) Avail: NTIS HC A02/MF A01 CSCL 11/6

A new theory of martensitic transformation based on the minimization of total strain energy has been developed, where the plastic relaxation strain (PRS) concept is introduced in order to relieve the high internal stress due to martensitic transformation in Ti, Ti-Mn, -Cr, -Ta, and -Zr alloys. For the analysis of Ti martensite, a total of 84 glide and twin systems were evaluated as PRS. For oblate spheroids with aspect ratio less than 0.01, (1,0,-1,1) --1,0,1,2= twin, (1,0,-1,1) --1,-1,2,3= glide and (1,1,-2,2) --1,-1,2,3= glide or twin systems produced strain energy minima at shear strain less than 2%, although crystal plasticity data of Paton and Backofen rules out the latter twin system. Theoretical predictions on habit plane in Ti, Ti-Ta and -Zr alloys turned out to be close to (334) sub B. In Ti-Mn and -Cr alloys, both (334) sub B and (344) sub B habit planes were predicted depending on the variant of (1,0,-1,1) --1,0,1,2= twin. These and other predictions are in excellent agreement with experimental observations. GRA

N77-11164# Battelle Columbus Labs., Ohio.
IMPLICATIONS OF ALLOY STRUCTURE WITH RESPECT TO MECHANICAL PROPERTIES Final Report
P. C. Gehlen and G. T. Hahn 12 Apr. 1976 76 p refs
(Contract N00014-70-C-0390)
(AD-A023832) Avail: NTIS HC A05/MF A01 CSCL 11/6

The overall goal of this program has been to develop computer algorithms that can model complex atomistic behavior in the most realistic possible way. A fundamental understanding of a few atomistic phenomena -- such as the motion of a dislocation or the breaking of a single interatomic bond at the tip of a crack -- can greatly help our understanding of the macroscopic properties of solids (such as their toughness and strength). Computer simulation appears to be ideally suited for this task. Although this program has been exclusively concerned with models of dislocations and crack tips in iron, all the computer algorithms are general and can be easily adapted to study other defects in any other material for which interatomic force laws are available. This report details how the original Brookhaven GRAPE model has been successfully modified to the current complex flexible boundary model. Key papers are included in a series of appendices. GRA

N77-11165# United Technologies Research Center, East Hartford, Conn.
DEVELOPMENT OF DIRECTIONALLY SOLIDIFIED EUTECTIC NICKEL AND COBALT ALLOYS Final Report, Nov. 1974 - Nov. 1975
F. D. Lemkey Dec. 1975 74 p refs
(Contract N62269-75-C-0129)
(AD-A024420; UTRC/R75-912046-4; NADC-76115-30) Avail: NTIS HC A04/MF A01 CSCL 11/6

Investigations to develop an isotropically ductile high temperature eutectic alloy first focused on identifying the cubic (gamma - alpha) phase field and the cubic plus (gamma - sigma) phase field within the quaternary systems, Ni-Cr-W-Al. Nickel alloys containing 0-15 w/o W, 2 w/o Al, and nominally 40 w/o Cr were shown to consist of a nickel-rich lamellar solid solution matrix saturated with tungsten and chromium, and aligned chromium rich lamellae containing nickel-rich Widmanstatten precipitate. Alloys containing 18 w/o W however consisted of a nickel-rich lamellar matrix and aligned sigma phase, identified by X-ray diffraction as approximately Cr8Ni5W. The attainment of significant low temperature ductility was found to be limited by the low ductility of sigma phase as previously observed for all multicomponent Ni-Cr-W-Al and Ni-Co-Cr-W-Al alloys containing 18 w/o W. Directionally solidified alloys with fully aligned gamma - alpha and gamma - sigma microstructures exhibited respectively either insufficient values of strength or ductility compared with conventional superalloys to be worthy of further development in this program. To meet the program objectives, alloys derived from the Ni3Al-Mo (gamma' - alpha) eutectic identified by us previously were selected for further investigation and optimization. Aluminum modifications of the pseudo-binary eutectic, gamma' - alpha, yielded ductile/ductile, gamma'/gamma - alpha aligned composite microstructures. GRA

N77-11166# California Univ., Los Angeles. Dept. of Materials.
SYNTHESIS OF NEW SUPERHARD MATERIALS AND THEIR APPLICATION TO CUTTING TOOLS Semiannual Report, 1 Apr. - 30 Sep. 1975
R. F. Bunshah and A. H. Shabaik 31 Oct. 1975 41 p refs
(Contract F44620-74-C-0044; ARPA Order 2574)
(AD-A024342; UCLA-ENG-7612; AFOSR-76-0321TR; SAR-3) Avail: NTIS HC A03/MF A01 CSCL 13/9

The process of Activated Reactive Evaporation is used to synthesize superhard materials like carbides, oxides, nitrides, ultrafine grain cermets. The deposits are characterized by hardness microstructure and lattice parameter measurements. The synthesis and characterization of TiC-Ni cermets, Al2O3 and VC-TiC alloy carbides is given. Tools of different coating characteristics are tested for machining performance at different speeds and feeds. The machining evaluation and the selection of coatings is based on the rate of deterioration of the costing, tool temperature, and cutting forces. Tool life tests show coated high speed steel tools show a 300% improvement in tool life. Author (GRA)

N77-11167# Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center.
STEEL FROM URBAN WASTE
Willard L. Hunter Jun. 1976 20 p refs
(PB-255441/8; BM-RI-8147; AMRC-1624) Avail: NTIS

HC A02/MF A01 CSCL 11F

A series of steel heats made in a one-ton arc furnace from ferrous urban waste and urban waste blended with heavy-melting scrap is described. The tests were conducted to determine if ferrous urban waste could be melted to produce steel having commercially acceptable properties. Selected 750-pound ingots from eight heats were rolled by a local steel bar mill to No. 5 reinforcing bar. The tests provided quantitative information on the effect of bulk density, tramp metal content, and oxide content of ferrous urban waste on the melting characteristics of these materials. GRA

N77-11168# National Bureau of Standards, Washington, D.C.
ELECTRON-MICROSCOPICAL STUDIES OF PASSIVE FILMS ON STAINLESS STEELS Final Report
J. Yahalom and L. K. Ives (Technion - Israel Inst. of Technology, Haifa) 1976 4 p refs Presented at Proc. of USA-Japan Seminar on Passivity and Its Breakdown on Iron and Iron Base Alloys, Honolulu, Hawaii, 10-12 Mar. 1975 p 69-71 Submitted for publication
(PB-255190/1) Avail: NTIS HC A02/MF A01 CSCL 11F

Transmission electron microscopy and diffraction were employed to study in situ films over corrosion pits in ferritic Fe-Cr alloys containing 5, 12 and 19 wt. percent Cr and in commercial AISI 304 and 316 stainless steels. The composition of passive films extracted from the pits was obtained by energy dispersive X-ray emission analysis. In all cases an enhanced concentration of Cr was observed, though to a lesser extent in the Fe-5% percent Cr alloy. A substantial difference in the crystalline structure and morphology was found to exist among the various alloys. The differences in passivity exhibited by the alloys and the mechanism of breakdown are discussed in light of these findings. GRA

N77-11169# National Bureau of Standards, Washington, D.C.
CHEMICAL BREAKDOWN OF PASSIVITY Final Report
Jerome Kruger 1976 9 p refs Repr. from Proceedings of USA-Japan Seminar on Passivity and Its Breakdown on Iron and Iron Base Alloys, Honolulu, Hi, 10-12 Mar. 1975 p 91-98 Sponsored in part by the Office of Naval Research, Arlington, Va.
(PB-255102/4) Avail: NTIS HC A02/MF A01

The various theoretical models for the chemical breakdown of passivity are reviewed. The models discussed are adsorbed in displacement, ion migration, or penetration and chemico-mechanical breakdown. The models are then related to data in the literature on breakdown initiation kinetics, critical potentials for breakdown, and alloy composition and structural and environmental factors. Based on the above examination a number of critical questions are posed that must be answered in order to understand chemical breakdown of the passive film. GRA

N77-11170# National Bureau of Standards, Washington, D.C.
ELLIPSOMETRIC SPECTROSCOPIC STUDY OF BREAKDOWN OF Fe-Cr AND Fe-Cr-Mo ALLOYS Final Report
C. L. McBee and J. Kruger 1976 3 p refs Presented at Proc. of USA-Japan Seminar on Passivity and Its Breakdown on Iron and Iron Base Alloys, Honolulu, Hawaii, 10-12 Mar. 1975, p 131-132
(PB-255203/2) Avail: NTIS HC A02/MF A01 CSCL 11F

Ellipsometric spectroscopy was recently applied to the study of the breakdown of passivity on pure iron single crystal surfaces. These studies first obtained a measurement of the ellipsometric parameters, delta and psi, as a function of wavelength for a passivated surface held at a potential in a buffered borate solution. Chloride ions were then added, and it was noted for most wavelengths that no changes were found during the induction period prior to breakdown. However, at a few wavelengths, delta and psi did vary with chloride additions. Using these changes and current measurements, it was possible to study events leading to the breakdown of Fe. GRA

N77-11171# Battelle Columbus Labs., Ohio.
COMPUTER-AIDED DESIGN AND MANUFACTURING FOR EXTRUSION OF ALUMINUM, TITANIUM, AND STEEL STRUCTURAL PARTS (PHASE 1) Final Report, 10 Feb. 1975 - 10 Feb. 1976
V. Nagpal and Taylan Altan Mar. 1976 216 p refs
(Contract DAAG46-75-C-0054)
(AD-A023946; AMMRC-CTR-76-6) Avail: NTIS HC A10/MF A01 CSCL 13/8

The overall objective of this program was to develop practical computer-aided design and manufacturing (CAD/CAM) techniques for extrusion of aluminum alloys, steels, and titanium alloys. This report covers the Phase-I work conducted in this program. This work was completed by performing the following major tasks: (a) review the present state of the art in extrusion die design and characterize the most commonly used extruded shapes, (b) divide these shapes into geometric modules and develop the CAD/CAM techniques for extruding a modular shape, (c) expand the results of the analysis, developed for a modular shape, to more practical simple shapes, such as L's, T's, and rectangles, and (d) perform extrusion trials with a rectangular shape to demonstrate the validity of CAD/CAM techniques. In order to enhance readability, the results of Phase-I work are presented in the form of three chapters as follows: (1) Die Design for Extrusion of Structural Shapes, (2) CAD/CAM of a Streamlined Die for a Modular Shape, (3) CAD/CAM of Streamlined Dies for Lubricated Extrusion of Simple Structural Shapes.
Author (GRA)

N77-11172# Cincinnati Univ., Ohio. Dept. of Materials Science and Metallurgical Engineering.
DEVELOPMENT OF HIGH FRACTURE TOUGHNESS IN MARAGING STEELS Final Report, 1 Jan. 1974 - 31 Dec. 1975
Stephen D. Antolovich 31 Dec. 1975 53 p refs
(Grant AF-AFOSR-2641-74; AF Proj. 9761)
(AD-A025096; AFOSR-76-0550TR; Rept-75-0397) Avail: NTIS HC A04/MF A01 CSCL 11/6

If 300 grade maraging steel is heat-treated to contain a distribution of tough austenite in an aged martensitic matrix, the fracture toughness can be improved significantly with only minimal decreases in the ultimate tensile strength. Studies have been carried out to determine the reasons for this increase. In particular the structure has been characterized by scanning (sem) and transmission electron microscopy (tem), plastic zone sizes and shapes have been determined by microhardness and etching techniques, plane-strain crack tip opening displacements have been measured under loading, and fracture surfaces have been examined both by scanning and replica electron fractography. In addition, a survey of the fatigue crack propagation (FCP) characteristics has been carried out. Some testing was done at -196 C. The fracture toughness of the specially treated steel was equivalent to what was obtained for conventionally treated steel at room temperature. This process was extended to the ultra high strength 350 grade steel and again a significant improvement in toughness was obtained although the magnitude of the increase was not as large as was obtained for the 300 grade steel. A model based on the energy absorbed during plastic deformtion of the austenite in the plastic enclave ahead of the crack tip has been proposed and is in good agreement with the experimental results. In some cases, heat treatments were used that result in formation of metastable austenite which transforms to martensite at crack tip on loading. This is a mode of plastic deformation that is responsible for very high toughness. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N77-11173 Princeton Univ., N.J.
THIXOTROPIC PROPERTIES OF POLYMER MELTS Ph.D. Thesis
In Choon Lim 1975 123 p
Avail: Univ. Microfilms Order No. 76-22602

The thixotropy of polymer melts is studied systematically by means of step change experiments. The orthogonal rheometer was used to provide a controlled homogeneous shear field. The problems arising in using this instrument for the transient experiments are discussed in detail. The concept of a structural parameter, A, which varies from zero to one, was introduced to

describe the breakdown and recovery of the internal structure of polymer melts. Several polystyrenes with different molecular weights were tested. The results show that the thixotropy of polymer increases with increasing molecular weight. Tests using polyethylene at several different temperatures demonstrate that the thixotropic effect increases with decreasing temperature.
Dissert. Abstr.

N77-11174*# Stanford Research Inst., Menlo Park, Calif.
PASSIVATION OF PIGMENT PARTICLES FOR THERMAL CONTROL COATINGS Final Report, Apr. 1974 - Sep. 1975
K. M. Sancier, S. R. Morrison, and E. P. Farley Sep. 1975 37 p refs
(Contract NAS8-21270)
(NASA-CR-150046) Avail: NTIS HC A03/MF A01 CSCL 11C

The preparation of a matrix of 48 samples consisting of pigments and pigmented paints is described. The results obtained from testing these samples by electron spin resonance and by in situ spectral reflectance measurements in space simulation tests are presented. Conclusions and recommendations for further research are given. Author

N77-11175*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF POTASSIUM TITANATE AS A COMPONENT OF ALKALINE FUEL CELL MATRICES
Robert E. Post Washington Nov. 1976 27 p refs
(NASA-TN-D-8341; E-8174) Avail: NTIS HC A03/MF A01 CSCL 10A

Various forms of potassium titanate were found to have almost complete resistance to chemical attack in 45 wt % KOH at 150 C (423 K) for up to 9600 hours. Electron microscopy and X-ray diffraction disclosed important differences with respect to fibricity and stability. The octatitanate appeared to possess the best combination of properties. It was concluded that potassium titanate could be produced in a more asbestos-like form. Fiber dispersion is important in matrix manufacture.Author

N77-11176# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.
INVESTIGATION INTO THE INFLUENCE OF NATURAL WEATHERING ON THE FIRE RESISTANT PROPERTY OF FFP 5.552 (F-COAT)
L. M. Godfried 11 Nov. 1975 5 p
(FOK-R-1932) Avail: NTIS HC A02/MF A01

Fire protection property of FFP 5.552 after long term natural weathering was investigated carrying out fire tests on samples. Changes in the surface temperature of the unexposed side of the sample after a fixed time (5 min) gave the best information on the fire protection property. Some incidental results of the fire protection property of FFP 5.552 with a top-coat are discussed. It was found that after approximately 4 years of natural weathering the fire protection of FFP 5.552 does not decrease significantly. A top-coat, however, will maintain the initial fire protection property more favorably. Author (ESA)

N77-11177# Krupp (Fried.) G.m.b.H., Essen (West Germany).
DEVELOPMENT OF HIGH PRESSURE DEVICES AND HIGH PRESSURE SYNTHESES Final Report
Wilhelm Ervens and Juergen Burbach Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 79 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.
(BMFT-FB-76-19) Avail: NTIS HC A05/MF A01; ZLDI, Munich, DM 16.20

The development of high pressure equipment for the synthesis of diamond is presented. The thermodynamic conditions of diamond synthesis for different kinds of carbon liberation are discussed. The development of high pressure - high temperature devices is described. A process to synthesize large diamonds from metal melts and a method to obtain polycrystalline diamond compacts from diamond sintering are given. These compacts can be used as inserts for cutting tools. Results of first machining tests with these compacts are described. Author (ESA)

N77-11178# Framan Distributors Ltd., Watford (England).
AN ANALYSIS OF DATA TAKEN FROM THE IMPACT VISCOMETER AT IMPERIAL COLLEGE Final Report
Graham R. Paul, Alastair Cameron, and Richard C. Gentle 3 Oct. 1975 29 p refs
(Contract N00014-75-C-0388; NR Proj. 229-016)
(AD-A023143) Avail: NTIS HC A03/MF A01 CSCL 11/8

The measurements of shear stress and shear rate are compared with the predictions of the 'limiting shear stress theory.' The results are compared with those that would be expected from an elastic, solid material. Author (GRA)

N77-11179# Picatinny Arsenal, Dover, N.J.
THE INITIATOR-ACTIVATOR RELATIONSHIP IN THE COLD-CURED POLYMERIZATION OF METHYLMETHACRYLATE
Jerome Rubin Mar. 1976 32 p refs
(AD-A023678; PA-TR-4824) Avail: NTIS HC A03/MF A01 CSCL 11/9

The profile of the room temperature polymerization of methyl methacrylate using initiator benzoyl peroxide and activator N, N-di-methyl-p-toluidine is shown to exhibit two exotherms indicative of a two-step process or mechanism. The time-temperature profiles clearly differentiate between the cases of extensive polymerization and poor polymerization. The rate of setup of the polymerization has been found to be related to the concentration levels of the initiator-activator and the mole ratios used. Although polymerization can be affected over a wide range of concentrations, there is an optimum mole ratio of initiator to activator that impacts the time factor. GRA

N77-11180# Princeton Univ., N.J. Dept. of Chemical Engineering.
STRUCTURE-PROPERTY RELATIONSHIPS BIBENZOXAZOLE POLYMERS CONTAINING FLUOROCARBON LINKAGES Technical Report, Jul. 1975 - Apr. 1976
J. K. Gillham and C. K. Schoff May 1976 22 p refs
(Contract N00014-76-C-0200)
(AD-A023822; TR-5) Avail: NTIS HC A02/MF A01 CSCL 07/3

A series of bibenzoxazole polymers has presented a unique opportunity to determine relationships between physical transitions and molecular structure. The results of oscillatory thermomechanical experiments show two glassy-state and a glass transition as amorphous transitions for each material above -180C. Each glassy-state transition is correlated with onset of motion of specific linkages, the flexibilities of which depend on the structure and molecular position of the linkages. The glass transition temperatures depend on the two relaxations (T - Tg) in a systematic manner. GRA

N77-11181# Picatinny Arsenal, Dover, N.J.
THE EFFECT OF STRAIN RATE AND TEMPERATURE ON POLYMERS
Jerome Rubin Mar. 1976 16 p
(DA Proj. 1T0-61101-A-91A)
(AD-A023774; PA-TM-2184) Avail: NTIS HC A02/MF A01 CSCL 07/3

The yield stress and elongation as a function of strain rate were investigated for two polyethylenes and two nylons. Both polyethylenes showed a higher degree of strain rate dependency up to 60% min than did either nylon. A linear relationship was shown to exist for a plot of the yield stress as a function of the log strain rate. The polyethylenes showed a sharp decrease in elongation as strain rate increased, whereas the nylon films were independent of the rate. The yield stress for the nylons decreased significantly as the temperature was increased from 20C to 110C. GRA

N77-11182# Goodyear Aerospace Corp., Akron, Ohio. Engineered Fabrics Div.
DESIGN AND DEVELOPMENT OF A 28 FOOT TANK, ELASTOMERIC COATED FABRIC, COLLAPSIBLE, PETROLEUM FROM A WOVEN TUBE CLOTH Final Report, Jun. 1975 - Jun. 1976
Ernest Knaus 6 May 1976 35 p
(Contract DAAG53-75-C-0249; DA Proj. 6A7-65706-M-985)
(AD-A025595; GAC-19-1035) Avail: NTIS HC A03/MF A01 CSCL 13/4

This report covers the development of collapsible fuel storage containers fabricated from a tubular woven cloth and coated with a polyurethane elastomer. The objective was to develop a collapsible fuel storage container that has only two end closure seams. GRA

N77-11183# Rockwell International Science Center, Thousand Oaks, Calif.
MECHANISMS OF ADHESION FAILURE BETWEEN POLYMERS AND METALLIC SUBSTRATES. PART 2: ALUMINUM 2024-T3 AND TITANIUM 6Al4V WITH HT424 ADHESIVE Final Report, 1 Apr. 1974 - 31 Aug. 1975
Tennyson Smith Oct. 1975 257 p refs
(Contract F33615-72-C-1641; AF Proj. 7342)
(AD-A025256; SC534.17FR-Pt-2; AFML-TR-74-73-Pt-2) Avail: NTIS HC A12/MF A01 CSCL 13/5

This report describes the continuation of a study of aluminum 2024-T3 alloy and titanium 6Al-4V alloy adherends, adhesively bonded with epoxy HT424 adhesive. The adherend surface properties, after standard preparation treatments, were characterized with a number of surface tools; Ellipsometry, surface potential difference (SPD), Auger electron spectroscopy (AES), electron, scanning electron and optical microscopy, contact angle, photo electron emission, and light scattering. A study was made of bond strengths after FPL etching and phosphoric acid anodizing and after aging of these surfaces in water vapor and in water. By calibrating the above mentioned instruments for hydroxide and organic films of known chemistry, it has been possible to discern the mechanism of aging degradation. The mechanisms of bond failure have been greatly elucidated by a careful study of the data. Suggestions are given to improve bond strength and stability based upon the analysis. Author (GRA)

N77-11184# Solar, San Diego, Calif.
STUDY OF EROSION MECHANISMS OF ENGINEERING CERAMICS Interim Technical Report, 1 Apr. - 31 Dec. 1975
Mary E. Gulden and Arthur G. Metcalfe Apr. 1976 69 p refs
(Contract N00014-73-C-0401; NR Proj. 032-542)
(AD-A025258; RDR-1778-4; ITR-4) Avail: NTIS HC A04/MF A01 CSCL 11/2

A glass bonded alumina radome material (Alsimag 614) was eroded under conditions which simulate a service environment. Natural occurring quartz in three particle size ranges (1-30 micrometers, 75-149 micrometers and 203-297 micrometers) accelerated to velocities ranging from 30 to 313 m/sec. was used for the erosive media. The weight loss threshold for mega particle impacts was determined for the three particle size ranges. Although the threshold particle kinetic energy varied over 2 1/2 orders of magnitude, it was found that the threshold energy density was constant. Strength measurements before and after erosion revealed that a significant strength decrease did not occur under these conditions for material removal up to a depth of 50 microns. An electron microscopy examination of surfaces after both single particle impact and mega particle impact was performed. Observation revealed that the two phase nature of the target affects erosion response to such a degree that the models developed for erosion of isotropic, elastic surfaces are not applicable. The appearance of the surfaces indicated that flow of the glassy grain boundary phase occurred. Simplified calculations based on superimposed hydrostatic compression indicate that plastic flow of the glass is possible under these erosion test conditions. Author (GRA)

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power*, *20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

N77-11185# Advisory Group for Aerospace Research and Development, Paris (France).
SMALL SOLID PROPELLANT ROCKETS FOR FIELD USE
Sep. 1976 113 p refs Proceedings held at 47th Meeting of the AGARD Propulsion and Energetics Panel, Linder Hoehe, Germany, 17-19 May 1976
(AGARD-CP-194; ISBN-92-835-0174-8) Avail: NTIS HC A06/MF A01

Technological problems are discussed for propulsion systems of advanced small rocket motors for antitank, anti-aircraft, and light artillery rockets. The noise and shock effects of these weapons are explored. For individual titles, see N77-11186 through N77-11196.

N77-11186# Service Technique de l'Aeronautique, Paris (France). Section Armements Missiles.
MILITARY ROCKET AIRCRAFT: INHERENT CONSTRAINTS AND THEIR USES [LES ROQUETTES D'AVIATION: CONTRAINTES INHERENTES A LEUR UTILISATION]
Claude Sengeissen *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 7 p In FRENCH (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

The capabilities and disadvantages of aircraft launched, self-propelled rockets are discussed. Transl. by A.H.

N77-11187# Advisory Group for Aerospace Research and Development, Paris (France).
SPECIFICATIONS OF THE PROPULSION SYSTEMS FOR ANTI-TANK ROCKETS [SPECIFICATIONS DES SYSTEMS DE PROPULSION DES ROQUETTES ANTI-CHARS]
Alain Fournier *In its* Small Solid Propellant Rockets for Field Use Sep. 1976 4 p In FRENCH (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

An elevated operating pressure with a temperature coefficient acceptable for full-time use; high combustion speed; and a sensibility to erosive combustion are required for propulsion systems of future anti-tank type, single-stage rockets.
Transl. by A.H.

N77-11188# Dynamit Nobel A.G., Cologne (West Germany).
DEVELOPMENT OF A SMALL SOLID PROPELLANT ROCKET MOTOR FOR FLEXIBLE RANGE REQUIREMENTS
Walter Helmut Diesinger *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 13 p refs (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

Ballistic properties of the conventional German light artillery rocket LAR I are described. The ratio of minimum to maximum range must be smaller to meet military requirements in second generation systems. A solid propellant rocket motor having two propulsive charges and two independent thrust periods of equal thrust levels is proposed. The charges are ignited in sequence by an electronic timing circuit at a predetermined time of delay for optimum thrust for maximum range. A.H.

N77-11189# Institut fuer Chemie der Treib- und Explosivstoffe, Pfinztal (West Germany).
HIGH ENERGY COMPOSITE DOUBLE BASE SOLID PROPELLANTS
W. Kloehn *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 14 p (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

Ammonium perchlorate is replaced by other oxidants as a constituent of composite double base solid propellants to prevent problems caused by hydrogen chloride in the combustion gases. Cyclic nitramines are substituted and tested. Fabrication techniques and properties of the propellants are discussed. A.H.

N77-11190# Centre de Recherches du Bouchet, Vert de Petit (France).
NEW PROPELLANTS FOR TACTICAL WEAPONS: SILANES [PROPERGOLS NOUVEAUX POUR ENGINS TACTIQUES: LES SILILANES]
G. Doriath *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 7 p In FRENCH (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

The fabrication process is described for composite propellants

using silicon as a binder, ammonium perchlorate as an oxidant, and aluminum as the reducing agent. The mechanical properties of silanes are discussed and applied to ballistic weapons.
Transl. by A.H.

N77-11191# Centre de Recherches du Bouchet, Vert de Petit (France).
STRONG IMPACT PROPELLANTS OF LITTLE SPECIFIC ATTENUATION FOR RADIOELECTRIC WAVES [PROPERGOLS A FORTE IMPULSION SPECIFIQUE ATTENUANT PEU LES ONDES RADIOELECTRIQUES]
G. Prigent *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 7 p refs In FRENCH (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

Temperature rise caused by post-combustion provokes an increase in electromagnetic waves. Composite propellants were studied to determine the effect of anti-attenuant additives on impact and combustion rate. Transl. by A.H.

N77-11192# Cranfield Inst. of Technology (England).
THE MEASUREMENT OF IGNITER HEAT FLUX IN SOLID PROPELLANT ROCKET MOTORS
I. E. Smith and K. M. Siddiqui *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 13 p refs (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

Using platinum thin film gauges, the temporal and axial distribution of heat flux was measured from two different types of igniter compositions and two different igniter geometries. The parameters used were different igniter masses, tube lengths, and nozzle throat diameters. The size distribution of the particulate matter arising from combustion of pyrotechnic materials was investigated. Whereas radiation plays an insignificant part in the total heat transfer process, the 'point' heat flux due to particulate heat transfer was found to be an important mode of heat transport during igniter action. Author

N77-11193# Ballistic Research Labs., Aberdeen Proving Ground, Md.
AN INTERIOR BALLISTICS MODEL FOR A SPINNING ROCKET MOTOR
Carl W. Nelson *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 6 p refs (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

A computer model was developed for the spinning motor used in an artillery projectile. Lumped parameter equations for conservation of mass and energy are solved numerically. Gas properties were studied mixing the input from two different propellant grains. Gas dynamic effects due to the swirling of gases through a single central nozzle were investigated. A formula for radial burning rates was derived. Author

N77-11194# Institut fuer Chemie der Treib- und Explosivstoffe, Pfinztal (West Germany).
DETERMINING THE SHELFLIFE OF SOLID PROPELLANTS
F. Volk *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 17 p refs (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

While stored at various temperatures between 65 C and 90 C, several double base propellants with the same composition, differing only in the stabilizer, were aged artificially to the onset of autocatalytic decomposition. A correlation between the temperature and the storage period was established for the results obtained at the respective temperatures. The continuing aging of the propellant gives rise to stabilizer reaction products which are characteristic of the respective aging condition. These reaction products may be used as a criterion for different stages of aging within the shelf life of solid propellants. Author

N77-11195# Technological Lab. RVO-TNO, Rijswijk (Netherlands). Rocket Section.
SIMPLE DETERMINATION OF THE MECHANICAL BEHAVIOR OF DOUBLE BASE ROCKET PROPELLANTS UNDER HIGH LOADING RATES
P. J. Greidanus *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 14 p refs (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

Two methods are discussed and evaluated for determining the mechanical behavior of double base rocket propellants. Uniaxial impact compression by an instrumented drop weight apparatus has advantages over tensile loading. Ultrasonic equipment is used to determine elastic properties and localize defects in propellant grains. Author

N77-11196# Institut Franco-Allemand de Recherches, St. Louis (France).
IMPULSIVE NOISE MEASUREMENT METHODS AND PHYSIOLOGICAL EFFECTS [METHODES DE MESURE DES BRUITS IMPULSIFS ET EFFETS PHYSIOLOGIQUES]
A. Dancer and M. Froboese *In* AGARD Small Solid Propellant Rockets for Field Use Sep. 1976 7 p refs In FRENCH (For primary document see N77-11185 02-28)
Avail: NTIS HC A06/MF A01

Exposure to complex impulse noise accompanying the firing of standard armaments results in headache, intense earache, and a sensation of deafness and may cause lesions to the inner and middle ear. Commercial pressure transducers were evaluated to determine reliability and used in determining precise measurements of the pressure pulses. Transl. by A.H.

N77-11197*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROPELLANT MATERIAL COMPATIBILITY PROGRAM AND RESULTS
L. R. Toth, W. A. Cannon, C. D. Coulbert, and H. R. Long 15 Aug. 1976 89 p refs
(Contract NAS7-100)
(NASA-CR-149149; JPL-TM-33-779) Avail: NTIS HC A05/MF A01 CSCL 21I

The effects of long-term (up to 10 years) contact of inert materials with earth-storable propellants were studied for the purpose of designing chemical propulsion system components that can be used for current as well as future planetary spacecraft. The primary experimental work, and results to date are reported. Investigations include the following propellants: hydrazine, hydrazine-hydrazine nitrate blends, monomethyl-hydrazine, and nitrogen tetroxide. Materials include: aluminum alloys, corrosion-resistant steels, and titanium alloys. More than 700 test specimen capsules were placed in long-term storage testing at 43 C in the special material compatibility facility. Material ratings relative to the 10-year requirement have been assigned. Author

N77-11198*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REDUCTION OF GASEOUS POLLUTANT EMISSIONS FROM GAS TURBINE COMBUSTORS USING HYDROGEN-ENRICHED JET FUEL Progress Report
Richard M. Clayton 15 Oct. 1976 58 p refs
(Contract NAS7-100)
(NASA-CR-149146; JPL-TM-33-790) Avail: NTIS HC A04/MF A01 CSCL 21D

Recent progress in an evaluation of the applicability of the hydrogen enrichment concept to achieve ultralow gaseous pollutant emission from gas turbine combustion systems is described. The target emission indexes for the program are 1.0 for oxides of nitrogen and carbon monoxide, and 0.5 for unburned hydrocarbons. The basic concept utilizes premixed molecular hydrogen, conventional jet fuel, and air to depress the lean flammability limit of the mixed fuel. This is shown to permit very lean combustion with its low NOx production while simulataneously providing an increased flame stability margin with which to maintain low CO and HC emission. Experimental emission characteristics and selected analytical results are presented for a cylindrical research combustor designed for operation with inlet-air state conditions typical for a 30:1 compression ratio, high bypass ratio, turbofan commercial engine. Author

N77-11199*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NITRAMINE PROPELLANT RESEARCH
N. S. Cohen (Harold Leeming and Assoc.) and L. D. Strand 15 Oct. 1976 133 p refs Sponsored in part by US Air Force
(Contracts NAS7-100; JPL-954444)

(NASA-CR-149148; JPL-TM-33-801) Avail: NTIS HC A07/MF A01 CSCL 21I

An extended model of the combustion of nitramine propellants is derived to account for multiple particle sizes, mixed oxidizers and active binders. Burning rates of various nitramine propellants are reported over the pressure range from 500 psi to 50,000 psi and show effects of systematic ingredient variations. A high pressure window bomb is utilized to observe the combustion process of these propellants by cinematography to a pressure of 6000 psi. The propellants are also extinguished by rapid decompression, and their surface and subsurface structures are studied with the aid of a scanning electron microscope. A computer program is developed to incorporate the model extensions and is applied to explain the experimental data. Parametric studies are performed with the model to formulate methods to achieve desirable burning rate characteristics in nitramine propellants. It is concluded that the model successfully describes the combustion of nitramine propellants and is a useful tool to evaluate combustion tailoring in association with propellant development efforts.

Author

N77-11200# Institute for Energy Analysis, Oak Ridge, Tenn.

METHANOL FROM COAL FUEL AND OTHER APPLICATIONS

Carl O. Thomas (Tenn. Univ.), Jeffrey W. Hodgson (Tenn. Univ.), Sydney L. Carroll (Tenn. Univ.), Thurman C. Hardin (Clemson Univ.), and Rafael Munoz-Candelario (Puerto Rico Univ.) Feb. 1976 61 p refs Sponsored by ERDA

(ORAU-126; LEA-75-2) Avail: NTIS HC A04/MF A01

The automobile accounts for about one-third of the petroleum consumption in the U.S. Other transportation sectors, utilities, manufacturing, industrial chemicals, residences, etc., also are heavy consumers. Project Independence goals require a significant reduction in petroleum imports which probably cannot be fully offset by increased domestic production. Three parallel actions therefore are necessary: conservation; improved fuel economy; and development of substitute liquid or gaseous fuels derived from coal, shale, or other carbonaceous raw materials. The technologies for conversion of coal to low-BTU gas and the subsequent synthesis of methanol already exist. The methanol fuel issues then are the technical suitability of methanol for large-scale fuel applications, energy yields versus other synthetic fuel strategies, economics, environmental effects, and competitive supply/demand considerations in terms of both raw materials and end uses. ERA

N77-11201# Brookhaven National Lab., Upton, N.Y.

HYDROGEN FOR ENERGY STORAGE: A PROGRESS REPORT OF TECHNICAL DEVELOPMENTS AND POSSIBLE APPLICATIONS

F. J. Salzano, C. Braun, A. Beaufrere, S. Srinivasan, G. Strickland, and J. J. Reilly Jan. 1976 37 p refs Presented at Eng. Found. Conf., Pacific Grove, Calif., 8 Feb. 1976 Sponsored by ERDA

(BNL-20931) Avail: NTIS HC A03/MF A01

The technologies of electrochemical hydrogen production and storage for application as an energy supply and storage media are developed. Work specifically aimed at the possible utilization of hydrogen in an electric utility is described. A system involving hydrogen production, storage and reconversion where the hydrogen is utilized strictly for eletric-to-electric storage applications is considered. The process and physical configuration, performance and costs of such a system are presented and discussed, as well as the prognosis for eventual application in a utility system. A more promising application involving the use of hydrogen in a dual mode system in which hydrogen is produced for direct injection into existing natural gas lines or utilized as a fuel cell fuel is also discussed. The key requirement necessary to make hydrogen production attractive for utility application is the flexible and maximum utilization of the capital facilities required for production, storage, and where applicable electric conversion. Author (ERA)

N77-11202# Mobil Research and Development Corp., Paulsboro, N.J.

DEVELOPMENT STUDIES ON CONVERSION OF METHANOL AND RELATED OXYGENATES TO GASOLINE Quarterly Progress Report, Aug. - Oct. 1975

S. E. Voltz and J. J. Wise Oct. 1975 22 p

(Contract E(49-18)-1173)

(FE-1773-14; QPR-3) Avail: NTIS HC A02/MF A01

A long-term aging test in the fixed bed pilot plant was terminated after 31 days on-stream. The catalyst activity decreased sharply after the third cycle. Catalyst deactivation appears to result from the steam constantly present in the conversion reactor. Product evaluations were concerned primarily with stability of gasoline product from the fixed bed pilot plant. In the first aging test, potential gums remained within acceptable limits until approximately the time of methanol breakthrough with high levels of additives. In contrast, gasoline stability appears much improved in the first cycle of the second aging test, with low potential gum formation maintained beyond methanol breakthrough. Filterability tests gave fair to good ratings at ambient and very cold temperatures for two composite gasoline samples from the fixed bed pilot plant. Author (ERA)

N77-11203# California Univ., Berkeley. Lawrence Berkeley Lab.

EFFECT OF OXYGEN-CATALYZED NUCLEAR SPIN CONVERSION ON THE LOW TEMPERATURE HEAT CAPACITY OF METHANE

G. J. Vogt Jan. 1976 192 p refs

(Contract W-7405-eng-48)

(LBL-4149) Avail: NTIS HC A07/MF A01

The heat capacity of solid methane has been measured from 0.4 to 28 K. In addition to measurements on pure methane, samples doped with approximately 0.9 mol percent of molecular oxygen were investigated in order to obtain equilibration among the three nuclear spin species. The use of oxygen-doped samples has made possible the measurement of nuclear spin effects which had proven to be experimentally intractable with pure methane samples. Also, the heat capacity of methane, exclusive of the nuclear spin effects, has been measured with pure samples for $T < 10$ K by extrapolating that portion of the afterdrifts where the nuclear spin and the lattice were relaxing toward equilibrium. These data have been interpreted and discussed with respect to the lattice and librational heat capacity of methane.

Author (ERA)

N77-11204# Institut Franco-Allemand de Recherches, St. Louis (France).

BEHAVIOR OF VARIOUS CONDENSATED EXPLOSIVES TO SHOCK WAVES CALIBRATED IN INTENSITY AND DURATION [COMPORTEMENT DE DIVERS EXPLOSIFS CONDENSES SOUMIS A DES ONDES DE CHOC CALIBREES EN INTENSITE ET DUREE]

Y. DeLongueville 26 Sep. 1974 23 p refs In FRENCH Presented at the 5th Intern. Colloq. on 'Dyn. des Gaz en Explosion et des Systemes Reactifs', Bourges, France, 8-11 Sep. 1975 Sponsored by Soc. Natl. des Poudres et Explosifs

(ISL-CO-211/75) Avail: NTIS HC A02/MF A01

An experimental setup to investigate the sensitivity of condensated explosives to shock waves calibrated in pressure and duration is presented and applied to granular, cast, and homogeneous explosives. The method described uses the technique of explosive lateral projection. Results are displayed as energy/shock duration and energy/shock pressure diagrams representing sensitivity thresholds; however, experimental results show that the concept of energy-constant threshold as sensitivity criterion is not applicable in all cases. ESA

N77-11205# Institut Franco-Allemand de Recherches, St. Louis (France).

LAGRANGE COORDINATE INTERIOR BALLISTIC CALCULATION MODEL Progress Report [INNENBALLISTISCHES RECHENMODELL IN LAGRANGESCHEN KOORDINATEN. STAND DER ARBEITEN]

G. Krauth 13 Oct. 1975 13 p In GERMAN Presented at the ICT Symp. on Innenballistische Leistungssteigerung der Rohrwaffen, Pfinztal-Berghausen, West Ger., 30 Sep. 2 Oct. 1975

(ISL-CO-215/75) Avail: NTIS HC A02/MF A01

The development of a gasdynamic model for interior ballistics is reported by means of a calculation example using the method of characteristics in Lagrange coordinates. Basic equations of all gasdynamic calculation models are the unsteady conservation

laws for mass, impulse, and energy. Two simplifications were applied to the model: the gas-producing material should be a solid propellant of defined geometrical shape, flowing with the gas stream, and the combustion products are dealt with as a homogeneous gas. ESA

N77-11206# Picatinny Arsenal, Dover, N.J.
NEW METHODS FOR THE MEASUREMENT OF RELATIVE IGNITABILITY AND IGNITION EFFICIENCY
Cecilio R. Grande Feb. 1958 30 p refs
(AD-A023862; PA-TR-2469) Avail: NTIS HC A03/MF A01 CSCL 19/1

A new laboratory method for determining the relative ignitability of artillery and rocket propellants was developed. A new method for judging the relative efficiency of igniter compositions was also developed. Relative ignitability data obtained by the laboratory method was found to correlate well with static firing test results. GRA

N77-11207# Applied Systems Corp., Vienna, Va.
THE PRODUCTION AND REFINING OF CRUDE OIL INTO MILITARY FUELS Final Report
Herbert Bartick, Kumar Kunchal, Duane Switzer, Robert Bowen, and Rita Edwards Aug. 1975 215 p refs
(Contract N00014-75-C-0055)
(AD-A024652) Avail: NTIS HC A10/MF A01 CSCL 21/4

The technical objectives of the program were to demonstrate that a wide spectrum of military operational fuels derived from shale oil crude could be obtained in a commercial industrial facility with minimum or minor modification, and to incentivize industry in oil shale development and technology. Shale oil crude was processed into gasoline, heavy fuel oil, and JP-4 in small laboratory quantities in the United States by the Bureau of Mines (ERDA) and private industry, however, no large scale commercial refining of the shale oil crude into a wide variety of products had been attempted up until this program. The various fuels produced met a majority of the military, federal, and commercial specifications requirements. However, these fuels tended to exhibit storage and thermal instabilities. In addition, the fuels contained a high wax content, high particulate matter, and high gum content. It is concluded that it is feasible to obtain military and civilian operational fuels from shale oil crude using a commercial refinery. However, additional effort has to be extended to overcome some refinery and operational problems to obtain maximum yields and improved properties. GRA

N77-11208# Deputy Chief of Staff for Research Development and Acquisition (Army), Washington, D.C.
REPORT OF THE ARMY SCIENTIFIC ADVISORY PANEL AD HOC GROUP ON FIRE-SAFE FUELS Final Report
Mar. 1976 17 p refs
(AD-A023763) Avail: NTIS HC A02/MF A01 CSCL 21/4

The vulnerability of combat vehicles to catastrophic fuel fires is of continuing major concern to the U.S. Army. An Army Scientific Advisory Panel Ad Hoc Group was organized to review the present Army Fire-Safe Fuel program and provide guidance for future research and development efforts in this area. The group advises long-term basic research, environmental impact and chronic toxicity programs be undertaken. Additionally, physical fuels management efforts, corrosion/material influence, and involvement of DARPA should be pursued. Extensive bibliography is included. Author (GRA)

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N77-11209 Massachusetts Univ., Amherst.
RAYLEIGH LINEWIDTH MEASUREMENTS IN LIQUID HELIUM Ph.D. Thesis
Edward Alan Lazarus 1976 151 p
Avail: Univ. Microfilms Order No. 76-22240

An apparatus was constructed for doing light scattering measurements on cryogenic fluids under pressure. The apparatus has the capability of measuring the width of the Rayleigh component of the optical spectrum at small angles. The technique used for the measurements is light beating spectroscopy. The range of allowable angles is 2.5 degrees to 10 degrees. The Rayleigh linewidth in liquid helium was measured over the range 2.6 K to 4.3 K; 2.3 atm. to 14.2 atm. The results are in agreement with the Mountain theory of the hydrodynamic spectrum. Preliminary linewidth measurements were made on gaseous Argon and Nitrogen at room temperature. Also, measurements were made of the melting curve in helium in the pressure temperature plane. These measurements were carried out along the superfluid-b.c.c. solid interface from the lower triple point to the upper lambda point. Dissert. Abstr.

N77-11210 Wesleyan Univ., Middletown, Conn.
SHAPE ANALYSIS OF PULSED SECOND SOUND IN SUPERFLUID HELIUM Ph.D. Thesis
Thomas K. Worthington 1976 80 p
Avail: Univ. Microfilms Order No. 76-23709

Second sound in He II has been observed using a heat pulse method. At temperatures where well developed second sound is observed, the entire pulse shape can be understood if heat sources and geometrical effects are properly taken into account. In the temperature range from 1.2 K to 0.75 K and the pressure range from 5 atm. to 24 atm., the attenuation coefficient and the velocity of second sound are measured using the shape analysis techniques developed. Dissert. Abstr.

N77-11211*# Hughes Aircraft Co., Culver City, Calif.
STUDY OF A VUILLEUMIER CYCLE CRYOGENIC REFRIGERATOR FOR DETECTOR COOLING ON THE LIMB SCANNING INFRARED RADIOMETER
Samuel C. Russo Jul. 1976 94 p refs
(Contract NAS1-14337)
(NASA-CR-145078) Avail: NTIS HC A05/MF A01 CSCL 20L

A program to detect and monitor the presence of trace constituents in the earth's atmosphere by using the Limb Scanning Infrared Radiometer (LSIR) is reported. The LSIR, which makes radiometric measurements of the earth's limb radiance profile from a space platform, contains a detector assembly that must be cooled to a temperature of 65 + or - 2 K. The feasibility of cooling the NASA-type detector package with Vuilleumier (VM) cryogenic regrigerator was investigated to develop a preliminary conceptual design of a VM refrigerator that is compatible with a flight-type LSIR instrument. The scope of the LSIR program consists of analytical and design work to establish the size, weight, power consumption, interface requirements, and other important characteristics of a cryogenic cooler that would meet the requirements of the LSIR. The cryogenic cooling requirements under the conditions that NASA specified were defined. Following this, a parametric performance analysis was performed to define the interrelationships between refrigeration characteristics and mission requirements. This effort led to the selection of an optimum refrigerator design for the LSIR mission. Author

N77-11212*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
EXPERIMENTAL AND ANALYTICAL STUDY OF THERMAL ACOUSTIC OSCILLATIONS Final Report
Lawrence W. Spradley, William G. Dean, and Zain S. Karu Aug. 1976 127 p refs
(Contract NAS8-31625)
(NASA-CR-150051; LMSC-HREC-TR-D496946) Avail: NTIS HC A03/MF A01 CSCL 20L

The thermal acoustic oscillations (TAO) data base was expanded by running a large number of tubes over a wide range of parameters known to affect the TAO phenomenon. These parameters include tube length, wall thickness, diameter, material, insertion length and length-to-diameter ratio. Emphasis was placed on getting good boiloff data. A large quantity of data was obtained, reduced, correlated and analyzed and is presented. Also presented are comparisons with previous types of correlations. These comparisons show that the boiloff data did not correlate with intensity. The data did correlate in the form used by Rott, that is boiloff versus TAO pressure squared times frequency to the one-half power. However, this latter correlation required a different set of correlation constants, slope and intercept, for each tube tested. Author

N77-11213*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN STUDY OF STEADY-STATE 30-TESLA LIQUID-NEON-COOLED MAGNET
George M. Prok and Gerald V. Brown Washington Nov. 1976 38 p refs
(NASA-TN-D-8337; E-8780) Avail: NTIS HC A03/MF A01 CSCL 20L

A design for a 30-tesla, liquid-neon-cooled magnet was reported which is capable of continuous operation. Cooled by nonboiling, forced-convection heat transfer to liquid neon flowing at 2.8 cu m/min in a closed, pressurized heat-transfer loop and structurally supported by a tapered structural ribbon, the tape-wound coils with a high-purity-aluminum conductor will produce over 30 teslas for 1 minute at 850 kilowatts. The magnet will have an inside diameter of 7.5 centimeters and an outside diameter of 54 centimeters. The minimum current density at design field will be 15.7 kA/sq cm. Author

N77-11214# National Bureau of Standards, Washington, D.C. Office of International Relations.
REGIONAL SEMINAR ON A SYSTEM OF STANDARDIZATION AND METROLOGY FOR LATIN AMERICA Final Report
H. Steffen Peiser and Robert S. Marvin Feb. 1976 100 p
(Grant PASA-TA(CE)-5-71)
(PB-254469/0; NBSIR-76-988) Avail: NTIS HC A05/MF A01 CSCL 14B

Papers are reported which were presented at the first of a series of Regional Seminars, organized under the technical guidance of NBS and sponsored by the U.S. Agency for International Development and the Direccion General de Normas y Tecnologia of Bolivia. The Seminar was held at La Paz on the 24th and 25th of June, 1974, with participants from Bolivia, Brazil, Chile, Ecuador, Korea, Peru, Turkey, Thailand, and the United States of America. The Seminar was organized into four sessions, each of one half day duration, covering: Session 1, 'Interactions for Information'; Session 2, 'Interactions for Standards'; Session 3, 'Interactions for Solutions to Technical Problems'; and Session 4, 'Interaction for Training'. GRA

N77-11215# Purdue Univ., Lafayette, Ind. School of Industrial Engineering.
THE OPTIMAL PLANNING OF COMPUTERIZED MANUFACTURING SYSTEMS Semiannual Report, 1 May - 31 Oct. 1975
Nov. 1975 147 p refs
(Grant NSF APR-74-15256)
(PB-252887/5; NSF/RA/T-75-056; QR-1) Avail: NTIS HC A07/MF A01 CSCL 13H

The development of a national methodology was investigated for optimal planning in the design and operation of computerized manufacturing systems. This is defined as a complex of machine tools, measuring devices, and storage facilities, totally interconnected for automatic operation and controlled by a digital computer. The project description, unit machining operations, scheduling theory and system simulation are reported. GRA

N77-11216# National Bureau of Standards, Washington, D.C. Office of International Affairs.
REPORT TO AID ON A PHILLIPINES SURVEY ON STANDARDIZATION AND MEASUREMENT SERVICES Final Report
H. Steffen Peiser and Robert S. Marvin Jun. 1976 124 p refs Sponsored by the Agency for Intern. Development
(PB-255803/9; NBSIR-76-1083) Avail: NTIS HC A06/MF A01 CSCL 14B

A survey of standardization and measurement services in the Philippines was carried out by a survey team May, 1975, as part of a National Bureau of Standards program sponsored by the Office of Science and Technology of the Agency for International Development. The team was divided into five groups which concentrated on: technical standards management, metrication, building technology, technical information handling, and testing facilities. Each group made extensive visits to the governmental, academic, and private organizations and facilities relevant to their topic. In each area the report summarizes the existing situation, identifies current problems, and offers suggestions and recommendations for their resolution. (GRA)

N77-11217# National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.
THE NATIONAL MEASUREMENT SYSTEM FOR SURFACE FINISH Final Report
Russell D. Young Mar. 1976 51 p refs
(PB-255809/6; NBSIR-75-927) Avail: NTIS HC A04/MF A01 CSCL 14B

The proposed system model is discussed including the role of standards committees, instrument manufacturers, and measurement users. The economic dimensions of the measurements impact areas and the technological base from which new measurement technology springs is described. GRA

N77-11218# National Bureau of Standards, Washington, D.C.
FIRE LOADS AND LIVE LOADS IN BUILDINGS Final Report
Charles Culver 1976 11 p refs Presented at the Intern. Conf. on Performance of Building Struct., Glasgow, 31 Mar. - 1 Apr. 1976 Submitted for publication
(PB-255864/1) Avail: NTIS HC A02/MF A01 CSCL 13L

The development of a nation-wide survey program for determining fire loads and live loads in buildings and establishing the factors which affect these loads is described. Considerations involved in planning the program and the type of data collected are included. Preliminary survey results obtained from the NBS Administration building are described. GRA

N77-11219# Naval Research Lab., Washington, D.C.
SURFACE CLEANING BY GLOW DISCHARGE IN HIGH VOLUME GAS FLOW Final Report
James P. Weston and William W. Balwanz 7 Apr. 1976 57 p refs
(AD-A024225; NRL-7973) Avail: NTIS HC A04/MF A01 CSCL 13/8

Surfaces of solids and the surfaces of domains within the solids are generally coated with contaminents which determine many of the mechanical properties of those surfaces (such as the ability to cold weld). This report describes a technique of cleaning the solid surface by continually purging a glow-discharge chamber with ultraclean, dry, and chemically inert gas during the flow-discharge phase. A large vacuum chamber is used which is 81 centimeters in diameter and 3 meters long. The purging gas is allowed to flow through the chamber, past the sample holder, at a rate of about 3 chamber volumes per minute. Such a large chamber is used instead of standard commercial glow-discharge devices to allow for many mean free paths for the contaminents to expand into and thus increase the time required to contact the chamber walls. This allows the sweeping action of the gas flow to move the contaminants downstream and thus reduce the probability of recontaminating either the chamber walls or the test surfaces. The cleaning effectiveness is compared by measuring the contact angles that high-surface-energy liquid drops make with the cleaned surface. The liquids used are triply distilled water for detecting by hydrophobic contamination and methylene iodide for detecting water contamination. The surfaces used to demonstrate the cleaning technique were stainless steel and aluminum oxide. Some of the contact angles were too flat to observe but were estimated to be less than 1 degree. The small contact angles are intrepreted to mean that there is less than 1 monomolecular layer of contaminant on the cleaned surface. Author (GRA)

N77-11220# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
A THEORETICAL PREDICTION TECHNIQUE FOR LATERAL HYDRODYNAMIC LOADS ON SIDEWALKS OF SURFACE-EFFECTS SHIPS Interim Report, Jul. 1974 - Jun. 1975
Robert E. Whitehead Dec. 1975 43 p refs
(AD-A024510; DTNSRDC/ASED/1216; DTNSRDC-4766) Avail: NTIS HC A03/MF A01 CSCL 13/10

A theoretical technique is developed to predict the lateral hydrodynamic forces on low aspect-ratio, parallel, sidewall-like shapes. A free surface is assumed, and the effects of cushion pressure and seals are neglected. Two sidewall, flow-field phenomena are modeled in the present technique. They are the

mutual interference of the sidewalls in the flow and contributions to the lateral forces and moments of vortices shed from the sidewall bottom edges. A three-dimensional, linear lifting-surface theory is used to predict attached flow, potential pressure distributions that reflect the mutual interference of the sidewalls in the flow field. The bound vorticity distribution is calculated from this pressure distribution and is used in a modified side-edge suction analogy to predict the force contributions due to the vortices shed from the sidewalls. The total hydrodynamic forces are the sum of the potential and the vortex induced loads. Rectangular parallel sidewalls with aspect-ratios of 0.1 and 0.2 are considered. Pressure distributions for different sidewall separation distances at yaw angles form 0 to 20 degrees are presented. Sideforce and yawing-moment coefficients are presented and are compared with experimental data for isolated rectangular wings. The influence of separation distance on the individual sidewall-force coefficients is clearly evident. Comparisons with experiment show reasonable results. The effect on the pressure distribution of a transom is investigated. The present technique predicts realistic pressure distributions for this case, using a simulated separated wake aft of the transom.

Author (GRA)

N77-11221# Advisory Group for Aerospace Research and Development, Paris (France).

APPLICATIONS OF NON-INTRUSIVE INSTRUMENTATION IN FLUID FLOW RESEARCH

May 1976 309 p refs In ENGLISH; partly in FRENCH Presented at the Fluid Dynamics Panel Symp., Saint-Louis, France, 3-5 May 1976

(AGARD-CP-193; ISBN-92-835-0176-4) Avail: NTIS HC A14/MF A01

The special and unique advantages of promising measuring concepts such as the Laser Doppler Velocimeter, electron beam, and Raman scattering are described. Emphasis is placed on measuring accuracies, limitations, corrections, and other problem areas. Techniques for measurement of velocity, thermodynamic properties, and other flow characteristics, in turbulent shear layers, flow fields, and combustion-mixing flows are included. For individual titles, see N77-11222 through N77-11248.

N77-11222# Institut Franco-Allemand de Recherches, St. Louis (France).

REVIEW ON HIGH SPEED APPLICATIONS OF LASER ANEMOMETRY IN FRANCE AND GERMANY **c35**

H. J. Pfeifer *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 18 p refs (For primary document see N77-11221 02-31)

Avail: NTIS HC A14/MF A01

The development and use of laser anemometry in various French and German high-speed wind tunnels is discussed. In these studies the fringe type anemometer was used exclusively because it is insensitive to vibrations and high sound levels. Moreover, this type of anemometer is supposed to give the most accurate results with respect to mean flow velocity and turbulence intensity. This is especially true if electronic counters are used as data acquisition systems. Both the optical arrangements and electronic designs are described in detail. All the investigations described relied on the natural dust particles present in the flow as velocity indicators. As a result of binational cooperation it is shown that in the wind tunnels considered the size distribution of dust particles fulfils almost completely the requirements of negligible particles lag. With some applications in high speed tunnel testing it is proved that laser anemometry is a standard measuring procedure, and that it yields results which may not be obtained by other methods. Author

N77-11223# Naval Surface Weapons Center, White Oak, Md.

APPLICATIONS OF THE LASER DOPPLER VELOCIMETER TO MEASURE SUBSONIC AND SUPERSONIC FLOWS **c35**

William J. Yanta and Benjamin J. Crapo *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 8 p refs (For primary document see N77-11221 02-31)

Avail: NTIS HC A14/MF A01

Measurements with a Laser Doppler Velocimeter (LDV) using the differential Doppler or fringe type of optical system were made in a variety of subsonic and supersonic flows. The application of this instrument at the Naval Surface Weapons Center (NSWC) to determine aerosol size distributions, to measure turbulence properties in supersonic boundary layers, to measure the mixing characteristics of two supersonic flows, and to measure the three-dimensional flow field around an axially symmetric body at large angles of attack in subsonic flow is discussed. Results show that the LDV can be a very useful tool for making nonintrusive measurements. Results also show that since the LDV measurements require micron-size particles to be present in the flow, care must be taken to insure that the particles will follow the flow accurately. Author

N77-11224*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LASER VELOCIMETRY APPLIED TO TRANSONIC AND SUPERSONIC AERODYNAMICS **c02**

D. A. Johnson, W. D. Bachalo, and D. Moddaress *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 12 p refs (For primary document see N77-11221 02-31)

Avail: NTIS HC A14/MF A01

As a further demonstration of the capabilities of laser velocity in compressible aerodynamics, measurements obtained in a Mach 2.9 separated turbulent boundary layer and in the transonic flow past a two-dimensional airfoil section are presented and compared to data realized by conventional techniques. In the separated-flow study, the comparisons were made against pitot-static pressure data. Agreement in mean velocities was realized where the pressure measurements could be considered reliable; however, in regions of instantaneous reverse velocities, the laser results were found to be consistent with the physics of the flow whereas the pressure data were not. The laser data obtained in regions of extremely high turbulence suggest that velocity biasing does not occur if the particle occurrence rate is low relative to the turbulent fluctuation rate. Streamwise turbulence intensities are also presented. In the transonic airfoil study, velocity measurements obtained immediately outside the upper surface boundary layer of a 6-inch chord MACA 64A010 airfoil are compared to edge velocities inferred from surface pressure measurements. For free-stream Mach numbers of 0.6 and 0.8, the agreement in results was very good. Dual scatter optical arrangements in conjunction with a single particle, counter-type signal processor were employed in these investigations. Half-micron-diameter polystyrene spheres and naturally occurring condensed oil vapor acted as light scatterers in the two respective flows. Bragg-cell frequency shifting was utilized in the separated flow study. Author

N77-11225# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.

APPLICATION OF THE DUAL-SCATTER LASER VELOCIMETER IN TRANSONIC FLOW RESEARCH **c35**

V. A. Cline (ARO, Inc., Arnold AF Station, Tenn.) and C. F. Lo (ARO, Inc., Arnold AF Station, Tenn.) *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 12 p refs (For primary document see N77-11221 02-31)

Avail: NTIS HC A14/MF A01

Topics, such as signal processing, signal-to-noise ratio, bandwidth, spatial resolution, and accuracy, are discussed in general for typical laser velocimeter (LV) systems. The particle lag problem and a data analysis scheme to minimize its effect are presented. Two experiments in a typical continuous aerodynamic transonic wind tunnel are discussed to demonstrate the technique. The data shown were taken with a two-component, dual-scatter, Bragg-cell type LV collecting back-scatter radiation from the abiment aerosol particles. The velocity field ahead of a hemisphere-cylinder was measured at low supersonic Mach numbers in the first experiment. The boundary-layer velocity characteristics in the shock-layer interaction region on a two-dimensional floor-mounted bump were also investigated. Both experiments pointed out the need for extreme care in data interpretation in certain flow regions. A new technique in data processing, designed to improve accuracy and increase data rate, is briefly introduced. Author

N77-11226# Royal Aircraft Establishment, Bedford (England).

THE APPLICATION OF A LASER ANEMOMETER TO THE INVESTIGATION OF SHOCK-WAVE BOUNDARY-LAYER INTERACTIONS **c34**

I. F. East *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 10 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

A detailed investigation of the interaction region of a normal shock wave and a two-dimensional turbulent boundary layer is described. The measurements were made with a two-component laser anemometer operating in the Doppler-difference mode and in backscatter. The details of the instrument and the method of analyzing the data are described. Shock wave boundary layer interactions with upstream Mach numbers of approximately 1.3, 1.4 and 1.54 were studied. The tests were made in the RAE 3ft x 3ft tunnel on the floor of the working section which was modified to be 915 mm wide by 762 mm high. The velocity and its direction were measured at about 1000 points. Both the complex inviscid interaction region of the flow as well as the boundary layer were investigated and an attempt was also made to make measurements in the separated flow. The emphasis is on demonstration of the capabilities of the laser anemometer rather than interpretation of the fluid mechanics. Author

N77-11227# Kent Univ., Canterbury (England). Physics Lab.
SUPERSONIC VELOCITY AND TURBULENCE MEASUREMENTS USING A FABRY-PEROT INTERFEROMETER c35
D. A. Jackson and P. L. Eggins *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 13 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The laser Doppler technique in which the frequency shift is analyzed using a high resolution confocal Fabry-Perot interferometer is discussed. Details of typical optical arrangements are given together with the associated electronic instrumentation used for data collection and signal processing. Experimental results are given for measurements made in a wide variety of experimental situations including flows with interacting shock fronts, turbulence, and large velocity gradients. Author

N77-11228# Institut Franco-Allemand de Recherches, St. Louis (France).
RECENT APPLICATIONS OF ISL OF THE LASER VELOCIMETER MEASUREMENTS IN TURBULENT FLOWS [APPLICATIONS RECENTES, A L'ISL, DE LA VELOCIMETRIE LASER AUX MESURES DANS DES ECOULEMENTS TURBULENTS] c35
X. Bouis *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 12 p refs In FRENCH; ENGLISH summary (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Introductory remarks deal with the accuracy and space/time resolution which can be attained with LDV systems in turbulent or high-velocity gradient flows. Some examples are given of the possibility of obtaining turbulent spectrum, autocorrelation, and simultaneous measurements of two velocity components. Already, these new methods give valuable information on transonic or heated flows. In the present phase however it is essential to strongly increase data rates and processing when time correlations are requested. Author

N77-11229# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
ANALYSIS OF THE OUPUT DATA OF A LASER DOPPLER VELOCIMETER c35
M. L. Riethmuller *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Laser Doppler Velocimeter measurements in gas flows require as low a seeding as possible. Such conditions can only be accommodated by period counters. These instruments have to process a signal with low signal to noise ratios. The smaller the number of signals, the lower the SNR. These processors have built-in noise rejection devices. One of them is a comparator which allows a selection of signal on an amplitude criterion. The response of the period counter to variable comparator or trigger level is analyzed and a systematic procedure is proposed for its adjustment. Author

N77-11230# California Inst. of Tech., Pasadena. Dept. of Aeronautics.
SINGLE SCATTERING PARTICLE LASER DOPPLER MEASUREMENTS OF TURBULENCE c34
Paul E. Dimotakis *In* AGARD Appl. of Non-Instrusive Instr. in Fluid Flow Res. May 1976 14 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Data reduction techniques are described to circumvent the problems of random, biased sampling of single scattering particle laser Doppler velocity measurements in turbulent flow. Two different methods are developed. For high mean data rates all statistical quantities are computed in an unbiased fashion through the use of time integrals. For low mean data rates statistical quantities can be computed in terms of ensemble averages where each event is weighed by the probability of its occurrence. The latter method will usually require a simultaneous measurement of at least two of the three velocity components of a single particle, and possibly all three depending on the shape of the focal volume. These techniques allow reliable measurements to be extracted from the data in cases where the scattering particle number density is uncorrelated with the local velocity vector. Other topics discussed include: (a) minimum sampling rate required if time integrals are used to compute averages and if no spectral information is desired; (b) frequency response of single scattering particle laser Doppler velocity; (c) apparent turbulence due to finite extent of measurement volume and curvature of velocity space correlation at the origin; and (d) flows for which laser Doppler velocimetry may not be a satisfactory measurement method. Author

N77-11231# Royal Aircraft Establishment, Farnborough (England).
DEVELOPMENT OF PHOTON CORRELATION ANEMOMETRY FOR APPLICATION TO SUPERSONIC FLOWS c35
J. B. Abbiss *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The development is described of a laser anemometer based on a photon correlator for experimental applications in transonic and supersonic wind tunnels at the Royal Aircraft Establishment. The equipment was designed to operate with a differential Doppler optical system in the backscatter mode in order to minimize the problems associated with traversing and alignment. The light source is an argon-ion laser which can be operated simultaneously at several frequencies in the visible spectrum. After initial experiments with an unseeded laminar flow in a small test section at Mach numbers up to 2.5, two component measurements were made on the flow around a cone at zero incidence in a laminar supersonic airstream. For these experiments the strong lines at 488 and 514.5 nanometers in the laser output were used, together with two Doppler difference optical systems and separate detectors. Controlled seeding with micron-sized particles was provided by an oil mist generator. The results of these experiments, together with those obtained with the same arrangement in a turbulent supersonic boundary layer, are presented. The principles of the photon correlation method are discussed and consideration is given to the experimental criteria which should be met in order to facilitate interpretation of the autocorrelation function. Author

N77-11232# Edinburgh Univ. (Scotland).
MEASUREMENT OF PERIODIC FLOWS USING LASER DOPPLER CORRELATION TECHNIQUES c34
F. H. Barnes, Q. I. Daudpota, T. S. Durrani (Southhampton Univ., Engl.), I. Grant (Napier Coll. of Tech., Edinburgh, Scotland), and C. A. Greated *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 10 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The application of photon correlation methods to the measurement of sinusoidally fluctuating flows is described. It is shown that with a laser Doppler optical configuration the correlation function for the Doppler signal is periodic with zero order Bessel function damping and that the amplitude of the velocity perturbation can easily be determined by locating the position of zeros of the Bessel function. For a two beam

configuration, the cross-correlation function is a distorted form of the velocity probability density function. Experiments were performed in a low turbulence wind tunnel in the wake of a circular cylinder using photon counting techniques for the Doppler signal analysis. The results of these experiments show the characteristic forms taken on by the correlation functions in the different locations. Measurements of velocity perturbation amplitudes obtained by visual inspection of the correlograms agree well with hot wire results. A curve fitting procedure for more accurate evaluation of the flow parameters is described.
Author

N77-11233# George Washington Univ., Washington, D.C. School of Engineering and Applied Sciences.
OPTICAL MEASUREMENTS OF THERMODYNAMIC PROPERTIES IN FLOW FIELDS. A REVIEW **c34**
R. Goulard *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 18 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The state of the art in optical measurement techniques in high temperature flows is assessed. Several forums and workshops were held on the subject in 1974 and 1975. A number of review papers on specific techniques appeared also during this period. This review discusses the performance criteria of interest in gas dynamics and evaluates the various existing or proposed techniques in the context of their use in basic and applied configurations.
Author

N77-11234# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LASER RAMAN DIAGNOSTICS OF AERODYNAMIC FLOWS AND FLAMES **c25**
Sylvie Druet, Robert Bailly, Michel Pealat, and Jean-Pierre Taran *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 12 p refs In FRENCH; ENGLISH summary (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Spontaneous Raman Scattering (SRS) is used for nonintrusive point concentration and temperature measurements in gas flows and reactive media. The main properties of the method and some of its typical achievements are reviewed. A second technique, coherent anti-Stokes Raman scattering (CARS) was developed and is found superior in the area of luminosity. An account of the limitations and of the field of applications of CARS is given.
Author

N77-11235# Institut Franco-Allemand de Recherches, St. Louis (France).
LOCAL MEASUREMENT AND PROPORTIONAL DENSITY OF GASEOUS FLOW BY RAMAN ANTI-STOKES COHERENT SCATTERING [MESURE LOCALE ET CONTINUE DE LA DENSITE D'UN ECOULEMENT GAZEUX PAR DIFFUSION COHERENTE RAMAN ANTI-STOKES] **c34**
A. Hirth *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 7 p refs In FRENCH; ENGLISH summary (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Coherent Raman scattering offers new possibilities for measuring concentrations and temperatures in gas flows. This technique was achieved by means of an original apparatus using two CW lasers as excitation sources. This allows the measurement of local density fluctuations in a flow. The experimental arrangement is described, its performances are analyzed (temporal and spatial resolution), limitations of the method are studied (the laser emission is disturbed when the flow is inside the cavity), and further improvements are proposed. The first results obtained with a N sub 2 flow are presented.
Author

N77-11236# Princeton Univ., N.J. Gas Dynamics Lab.
THE ELECTRON BEAM FLUORESCENCE TECHNIQUE APPLIED TO HYPERSONIC TURBULENT FLOWS **c02**
Jerome A. Smith and James F. Driscoll (Michigan Univ.) *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 10 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Several factors concerning the use of the electron beam fluorescence technique to make time resolved density and temperature measurements in relatively high density turbulent flows are discussed. Experience derived from a recent study of a M = 16.3 adiabatic tunnel wall boundary layer in helium is used to outline many difficulties to be encountered in the application of this broad bandwidth, nonintrusive technique to study hypersonic turbulent flows in general. Collision quenching, attenuation and other beam broadening effects are described. In addition, data analysis procedures often asymmetrically distributed about the mean fluctuations are discussed. For example, evidence is presented to show that mean intensity data does not provide mean flow property information in general. Primary emphasis is on results obtained in helium with recent work by others in air and nitrogen flows cited, especially where differences exist.
Author

N77-11237# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
QUALITATIVE AND QUANTITATIVE FLOW FIELD VISUALIZATION UTILIZING LASER-INDUCED FLUORESCENCE **c35**
C. Forbes Dewey, Jr. *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 7 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Liquids or gases containing fluorescence molecules may be stimulated in a spatially controlled manner by the use of a laser. The resulting patterns of fluorescence may be analyzed to yield spatially resolved information on flow velocity, density, and mass transfer. Information may be recorded on TV tape, photographically, or monitored using focused optics and a photodiode detector. Several examples are described to illustrate the method; mass transfer between an external flow and a region of separation; visualization of axisymmetric starting vorticies; location of turbulent reattachment points; and instability modes of confined jets.
Author

N77-11238# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CHARACTERIZATION OF NOISE SOURCES IN HOT JETS BY THE CROSSED BEAM TECHNIQUE [CARACTERISATION DES SOURCES DE BRUIT DANS LES JETS CHAUDS PAR LA TECHNIQUE DES FAISCEAUX CROISES] **c34**
Mariano Perulli, Jean-Francois DeBelleval, and Jean Maulard *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p refs In FRENCH; ENGLISH summary (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The sounding of simple or coaxial, cold or hot free jets by optical systems makes up a measuring means external to the medium investigated. More especially, the use of radiometers measuring infrared emissions gives access to spatio-temporal data that are tightly coupled to turbulence parameters. These data can be obtained by crossed beam techniques. The physical meaning of the signals issued from the radiometers, as well as their interpretation after processing, are discussed and compared with those obtained by other types diagnostic. In spite of the difficulties pertaining to the optical system and to the crossed beam measuring technique, it is shown, as a conclusion, that this methodology does, in some precise cases, reach its objective: to characterize noise sources.
Author

N77-11239# Princeton Univ., N.J.
RESONANT DOPPLER VELOCIMETER **c35**
Richard B. Miles *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 8 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Resonance fluorescence is a potentially useful tool for studying hypersonic flowing gases. This paper discusses the measurement of velocities and demonstrates visualization techniques using sodium seeded into helium flows. A narrow linewidth dye laser is tuned onto the sodium resonance line. The Doppler shift of the absorption frequency yields the velocity profile, and the fluorescence provides direct flow visualization. Other flow properties such as the turbulence frequency, temperature, etc. may also be measured.
Author

N77-11240# Purdue Univ., Lafayette, Ind. Applied Optics Lab.
FRINGE MODE FLUORESCENCE VELOCIMETRY c35
Warren H. Stevenson, Reginaldo DosSantos, and Stephen C. Mettler *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 9 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

A modified technique in which the standing electromagnetic field induces a time varying fluorescent emission from liquid droplets doped with a suitable organic dye is described. The fluorescence consists of a band of wavelengths not including the incident laser light and therefore can be passed by a filter which blocks the laser wavelength. This can significantly improve the signal to noise ratio or allow signal detection only from those particles deliberately added to the flow. An extensive study was carried out to determine factors which influence the quality of the fluorescence signal. The effect of dye concentration in the solvent and other environmental factors were investigated. Data obtained to date indicate that the fluorescence signal is of the same order of magnitude as the scattered light signal only in the case of a backscatter system. Author

N77-11241# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Linder Hoehe (West Germany).
THE LASER-DUAL-FOCUS FLOW VELOCIMETER c35
R. School *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 9 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The use of a low cost rotating radial diffraction grating as a beam splitting frequency shifter for operation in laser Doppler velocimeter systems is discussed. A high efficiency phase grating is used that can be exposed to high power laser beams. A compact optical design is described having a grating disc with a diameter of 35 mm and a line density of 166 line pairs per mm. Several optical arrangements, operating as well in the fringe mode as in the reference beam mode, are studied. The advantages of these arrangements are the simple set-up and the ease of optical alignment, which become significant for the two and three component systems. Author

N77-11242# Technisch Physisch Dienst TNO-TH, Delft (Netherlands).
THE USE OF ROTATING RADIAL DIFFRACTION GRATINGS IN LASER DOPPLER VELOCIMETRY c35
J. Oldengarm *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 6 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The use of a low cost rotating radial diffraction grating as a beam splitting frequency shifter for operation in laser Doppler velocimeter system is considered. A high efficiency phase grating is used that can be exposed to high power laser beams. A compact optical design is described having a grating disc with a diameter of 35 mm and a line density of 166 line pairs per mm. Several optical arrangements, operating as well in the fringe mode as in the reference mode, are discussed. The advantages of these arrangements are the simple set-up and the ease of optical alignment, which become significant for the two and three component systems. Author

N77-11243# Atomic Energy Commission Research Establishment, Riso (Denmark). Electronics Dept.
THE TIME-OF-FLIGHT LASER ANEMOMETER c35
L. Lading *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 20 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The time of flight laser anemometer is based on measuring the time of flight between two small volumes in space by correlation techniques. It is shown that this anemometer can generally give the same kind of information as can be obtained with a laser Doppler anemometer, and that in some specific cases the space time resolution is even better than for the laser Doppler anemometer. The uncertainties on the measured values are discussed in relation to the statistical properties of the measuring system and signal processing. The effects of spatial and temporal velocity fluctuations are analyzed. With the anemometer it is possible to obtain a particle size versus particle velocity spectrum, provided that the particles are larger than the focal beam diameters in the flow direction. The anemometer was used for measurements in a two phase flow surrounding a simulated fuel rod. The configuration was also used under extremely low light level conditions (an average number of photon counts less than one per transit through one spot) to measure gas velocity. Author

N77-11244# Ruhr Univ., Bochum (West Germany).
CURRENT PROBLEMS OF OPTICAL INTERFEROMETRY USED IN EXPERIMENTAL GAS DYNAMICS c74
Wolfgang Merzkirch *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Optical interferometry is surveyed for its role to deliver quantitative values of gas density and concentration when applied to gas dynamic measurements. It is shown that optical interferometers can be classified into two groups, according to their ability to measure either the density directly or the density gradient. Emphasis is placed on two major problems: the evaluation of interferograms taken of three dimensional test fields, and the correction for light refraction in fields with strong refractive index gradient. Author

N77-11245# Politecnico di Milano (Italy).
FLOW FIELD IN THE WAKE OF A BLUNT BODY BY LASER DOPPLER ANEMOMETRY c02
F. Cignoli, A. Coghe, U. Ghezzi, and S. Pasini *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The flow field in the wake of a blunt body was investigated by laser Doppler anemometry. The cold flow and the flow with chemical reactions was considered in order to determine directly the combustion influence on the flow field. Premixed methane-air flame was obtained with a 20 mm inner diameter tube burner. A disc of the same external diameter was positioned, coaxially, 30 mm higher on the burner mouth. Both the situations, where the blunt body is only an obstacle generating a wake and where it acts as a flame stabilizer, were analyzed. Flame front crossing, in laminar premixed flames, was also carefully analyzed. Experiments were carried out by means of different LDA signal processors and in different conditions of scattering particles. Both the mean and fluctuating velocities were measured in the axial and radial directions. The analysis of results was not intended to a flame structure discussion, but rather to a critical examination of LDA measurements in connection with some specific problems: particle behavior, turbulence effects, resolution of turbulence fluctuations, minimum particle concentration, performances of different LDA signal processor. Author

N77-11246# National Gas Turbine Establishment, Pyestock (England).
INVESTIGATION OF A V-GUTTER STABILIZED FLAME BY LASER ANEMOMETRY AND SCHLIEREN PHOTOGRAPHY c25
H. Clare, D. F. G. Durao (Imperial College, London), A. Melling (Imperial College, London), and J. H. Whitelaw (Imperial College, London) *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 10 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

Laser Doppler anemometry was used to study premixed propane air flames stabilized on a V gutter, both in smooth combustion and in buzz. Axial velocity measurements in the wake of the gutter were made in an isothermal flow and in a combusting flow to examine the influence of combustion on the velocity distribution and the recirculation zone length. Velocities outside the wake in a moderate buzz condition were measured, but velocity pulsations corresponding to the regular fluctuations in static pressure observed by means of a pressure transducer mounted in the duct wall could not be detected by the technique used. A separate study using high speed cine schlieren photography, has revealed cyclic variations in the flame structure at the same frequency as the observed pressure pulsations. Author

N77-11247# United Technologies Research Center, East Hartford, Conn.
SIMULTANEOUS LASER MEASUREMENTS OF INSTANTANEOUS VELOCITY AND CONCENTRATION IN TURBULENT MIXING FLOWS **c36**
F. K. Owen *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 7 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

A nonperturbing capability for the simultaneous, local measurement of instantaneous velocity and concentration was developed and is described. The technique is being used in the study of turbulent mixing flow fields and its application is illustrated by measurements obtained in the initial mixing region of two confined coaxial jets. Author

N77-11248# Brown Univ., Providence, R. I.
A THREE-COMPONENT LASER-DOPPLER-VELOCIMETER **c35**
T. Gunnar Johansson (Chalmers Univ. of Tech., Sweden), Lars F. Jernqvist (Chalmers Univ. of Tech., Sweden), Sture K. F. Karlsson, and Nils Froessling (Chalmers Univ. of Tech., Sweden) *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 4 p (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

The development of a three component laser Doppler velocimeter is described. It utilizes four incoming beams which are all frequency shifted. Three of the beam propagate in one plane and form three dual beam arrangements. Two of these are used to measure two independent velocity components in this plane. The fourth beam propagates outside this plane and forms together with one of the first three beams a third dual beam arrangement, which measures a velocity component in a direction out of the plane formed by the first three beams. The frequency shifts are chosen so that three signals can be identified corresponding to three independent directions. The system is to be tended to measurements in five points simultaneously. The signal is fed into three phase locked loops and the frequencies generated by their local oscillators are counted, sampled digitally and stored on magnetic tape for later processing on a digital computer. Author

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

N77-11249 Massachusetts Univ., Amherst.
RADIO-FREQUENCY WAVE COUPLING AND MODE CONVERSION AT THE LOWER HYBRID RESONANCE Ph.D. Thesis
Kwan Cheung Wong 1976 88 p
Avail: Univ. Microfilms Order No. 76-22251

Linear mode conversion near lower hybrid resonance is studied in a one dimensional, weakly inhomogeneous magnetoplasma. WKB approximations and connection formulas are used. The analysis is based on the cold-, warm-, and hot plasma approximations depending on the ratio of the ion Larmor radius to the perpendicular wavelength. Mode conversion is found to take place in two different locations. An appropriate differential equation is derived to describe the electric field in each of the mode conversion regions. A complete conversion of a long wavelength mode to a short wavelength mode is confirmed in both regions. The radio frequency energy coupled into the plasma and the surface impedance of the plasma are computed for slow wave excitations. Collisional effects are seen to greatly reduce the efficiency of mode conversion. Dissert. Abstr.

N77-11250 Pennsylvania Univ., Philadelphia.
TRANSIENT BEHAVIOR OF AN ADAPTIVE ARRAY Ph.D. Thesis
Edwin D. Banta 1976 114 p
Avail: Univ. Microfilms Order No. 76-22651

An adaptive array is analyzed using the gradient search algorithm to control its complex weights. A root trajectory method is developed to depict the entire adaptive array transient behavior in one diagram. The control algorithm seeks to overcome the difficulty of extraneous nulls by direct control of the null locations instead of indirect control through the complex weights. In the case of one signal all nulls converge to the signal location; however, when two signals are present the nulls converge to a saddle point. In the absence of noise the nulls would remain at the saddle point, but computer solutions show that with the randomizing influence of noise, the nulls do converge to the signal locations. Dissert. Abstr.

N77-11251 New Mexico Univ., Albuquerque.
OPTIMAL LINEAR CODING FOR A MULTICHANNEL SYSTEM Ph.D. Thesis
Kyong-Hwa Lee 1975 146 p
Avail: Univ. Microfilms Order No. 76-22153

An optimal linear vector coding (transformation) method is described that matches an r-dimensional vector signal and a k-dimensional channel under a given channel power constraint. The encoder converts the r correlated random variables into r independent random variables and selects at most k independent random variables which correspond to the k largest eigenvalues of the signal covariance matrix Q. Cross correlation is reinserted into the k random variables in such a way that the largest eigenvalue of Q is assigned to the smallest eigenvalue of the channel noise covariance matrix R and the second largest eigenvalue of Q to the second smallest eigenvalue of R. The extension to time-discrete dynamic vector signal via the Kalman formulation and the wave-number domain approach for the multidimensional vector field signal are also presented. Dissert. Abstr.

N77-11252 Polytechnic Inst. of New York.
THE MODELING OF MESSAGE SWITCHES IN STORE-AND-FORWARD COMPUTER COMMUNICATION NETWORKS Ph.D. Thesis
Daniel John Paulish 1976 204 p
Avail: Univ. Microfilms Order No. 76-23438

A network approach is developed for constructing a message switch model from which the message processing delay can be determined as a function of the input traffic statistics. The model requires a knowledge of computer service times which are determined by modeling a multicomputer, multichannel, multidisk system, based upon the assumption that the service times consist primarily of cumulative disk accessing times. Model parameters of interest are determined using analytic and approximate queuing theory techniques. A new channel waiting model is introduced to account for disks competing for a smaller number of channels, causing the disk queue service times to be traffic rate-dependent. A method for determining computer service times is formulated, and techniques are developed for approximating the disk access per message distribution and an overlap factor which accounts for simultaneous disk accesses over more than one channel. Dissert. Abstr.

N77-11253 Houston Univ., Tex.
THE INFINITELY LONG YAGI ARRAY OF CONCENTRIC CIRCULAR LOOPS Ph.D. Thesis
George Wadih Raffoul 1976 214 p
Avail: Univ. Microfilms Order No. 76-21865

An analysis of wave propagation on an infinitely long Yagi array of concentric circular loops is presented. A dispersion relation is derived and numerically solved for the phase velocity of the wave. It is also shown that the character of wave propagation on a concentric array remains intact under an arbitrary axial displacement of inner loops relative to outer ones. When the outer loop is made extremely large, the concentric array reduces to an isolated array of single loops with one passband per mode. The phase velocities of the propagating waves in the latter case are used to obtain optimum design parameters for the Yagi antenna of circular loops. In the first mode of operation, the Yagi antenna of circular loops radiates mainly in the endfire direction, and in the second mode, the radiation is in a conical shell pattern. Applications of the concentric array of circular loops, yagi antennas, surface waveguides, TWT interaction circuits,

microwave filters, and open-structure resonators are discussed.
Dissert. Abstr.

N77-11254 Syracuse Univ., N.Y.
ANALYSIS OF ARBITRARILY ORIENTED THIN WIRE ANTENNA ARRAYS OVER IMPERFECT GROUND PLANES Ph.D. Thesis
Tapan Kumar Sarkar 1975 105 p
Avail: Univ. Microfilms Order No. 76-18561

The development of fast and accurate techniques for computation of the characteristics of antenna systems is considered. An important problem is the evaluation of certain semi-infinite integrals encountered in the exact Sommerfeld solution. The time required for computation of these integrals is reduced by the application of interpolatory quadrature formulas. The approximate reflection coefficient method is derived from the Sommerfeld formulation via the method of steepest descent. The accuracy of the reflection coefficient method relative to the Sommerfeld method is discussed. Finally, formulas convenient for the optimization of various performance indices are discussed. Typical indices that have been optimized, both with and without constraints, are directivity, power gain, quality factor, and main beam radiation efficiency. Dissert. Abstr.

N77-11255 Princeton Univ., N.J.
FINITE WORDLENGTH IN DIGITAL SIGNAL PROCESSING Ph.D. Thesis
Tran Thong 1975 155 p
Avail: Univ. Microfilms Order No. 76-22608

Certain aspects of the finite word-length effects in digital signal processing are investigated. An understanding of these effects is necessary for the design of efficient signal processors. Two types of digital processors are investigated: the fast Fourier transform processor and the digital filter. The accumulation of roundoff error is analyzed for the fixed point arithmetic implementation of the fast Fourier transform (FFT) algorithms. The various FFT algorithms are analyzed when the operations are performed using either rounding or two's complement truncation. Overflow in the additions is also considered. Roundoff error in the floating point implementation of the various FFT algorithms is studied. The emphasis is on the implementation on either a minicomputer or a dedicated processor, where the operations can be controlled exactly as desired. Dissert. Abstr.

N77-11256 Illinois Inst. of Tech., Chicago.
ELECTRIC FIELD IN THE FOCAL REGION OF AN OFFSET PARABOLIC RECEIVING ANTENNA Ph.D. Thesis
Anthony Rocco Valentino 1976 113 p
Avail: Univ. Microfilms Order No. 76-23504

The offset paraboloid is analyzed in the reception mode and the current distribution induced on the reflector is determined first from the physical optics approximation. Then this current distribution is treated as the source and the electric field in the focal region is formulated as a double integration over this surface current source. Integration over the induced current rather than the effective aperture field distribution has the advantage that the effects of the axial currents on the reflector are included. An approximation is made to the phase term which allows one of the integrations to be performed in closed form. The result is a relatively simple, single integration formulation. The formula predicts both the principal and cross polarized fields. The results obtained from this formula compare favorably with experimental results and special cases presented by other authors.
Dissert. Abstr.

N77-11257 George Washington Univ., Washington, D.C.
SIMULATION OF AUTOMATIC DETECTION AND TRACK-WHILE-SCAN SYSTEMS FOR UNSTABILIZED SHIPBOARD RADARS Ph.D. Thesis
David Marvin White 1976 178 p
Avail: Univ. Microfilms Order No. 76-21767

The problems associated with operating automatic detection and track-white-scan systems with unstabilized shipboard search radars are investigated. A simulation program is developed to study the problems, with emphasis on the performance limitations imposed by multipath and roll and pitch motions of the platform. The simulation program is used to examine the azimuth errors and track-while-scan performance of the baseline automatic track-while-scan system operating with UHF radars at 400 and 1000 MHz. It is shown that multipath distortion has a significant effect on the roll and pitch induced azimuth bias errors for a 400 MHz radar. As a result, the ideal azimuth bias prediction is generally invalid for 400 MHz radars and cannot be used for correcting the azimuth measurements even if the target elevation angle is known. The azimuth accuracy is shown to degrade by almost a factor of ten for high roll and pitch conditions.
Dissert. Abstr.

N77-11258 Syracuse Univ., N.Y.
RESPONSE OF LINEAR DISCRETE SYSTEMS TO MODULATED SEQUENCES Ph.D. Thesis
Jack Byron Williams 1975 167 p
Avail: Univ. Microfilms Order No. 76-18572

The response was examined of linear discrete-time filters that result from uniform sampling of conventional modulated carriers. It is shown that the commonly encountered modulation types results in either amplitude modulated sequences or phase modulated sequences. The minimum sampling rate required for reconstruction of the modulating signal is derived for each type of modulation. The bandwidth of the modulated sequence is determined for the cases where the minimum sampling rate is exceeded. The quasi-stationary response of filters is defined and a correction term which represents the difference between the actual response of a filter and the quasi-stationary response is derived for both amplitude and phase modulated sequences. Bounds on the correction term are obtained so that it is possible to predict whether or not the output of a filter behaves in a quasi-stationary manner. The bounds are also used to bound the total response of the filter. The correction term is used to simplify computation of the response of discrete filters to abrupt modulations such as frequency or phase shift keyed carriers.
Dissert. Abstr.

N77-11259 Polytechnic Inst. of New York, Brooklyn.
ROBUSTIZED RECURSIVE ESTIMATORS AND ADAPTIVE PARTITION DETECTORS Ph.D. Thesis
Paul Richard Kersten 1976 209 p
Avail: Univ. Microfilms Order No. 76-23418

Robustized recursive estimators and adaptive partition detectors are investigated for a mixture distribution composed of a low variance noise component and an impulsive noise component. In such a noise environment, nonparametric detectors have significant advantages. Specifically, the m-interval partition detector, which is a generalization of the classic sign test, has shown great promise. To implement this test, a finite number of quantiles of the underlying noise distribution must be estimated. This requires a recursive nonparametric estimation procedure which is also robust. Accordingly, robustized recursive estimators are examined in a general setting and then applied to the estimation of quantiles and other problems. Dissert. Abstr.

N77-11260 Polytechnic Inst. of New York, Brooklyn.
CENTRALIZED TELEPROCESSING NETWORK DESIGN Ph.D. Thesis
Aaron Kershenbaum 1976 139 p
Avail: Univ. Microfilms Order No. 76-23417

The problem considered is that of finding an optimal (minimum cost) design for a centralized teleprocessing network given a set of locations, traffic magnitudes between these locations, and a single common source or destination. The vast majority of telecommunication networks currently in existence is of this type. Several heuristics, which are efficient (in terms of their execution time and memory requirements on a digital computer) and which produce seemingly good results, have already been developed and are currently accepted techniques. Some work was also done on finding optimal solutions to this problem both as a design tool and as a means of verifying the effectiveness of proposed heuristics. Currently known techniques for the optimal solution of this problem via integer programming have fallen short of the desired objective as they require too much memory and running time to be able to treat problems of realistic size and complexity. Dissert. Abstr.

N77-11261 Marquette Univ., Milwaukee, Wis.
PERFORMANCE OF MICROWAVE DIODES AS DETECTORS AND MIXERS WITH RESPECT TO THEIR DEVICE PARAME-

TERS Ph.D. Thesis
Ken-Wang Hsu 1976 203 p
Avail: Univ. Microfilms Order No. 76-21748

Detection and mixing of X band signal and M band signal by both S band and X band diodes were studied experimentally and theoretically. Tangential signal sensitivity and noise figures were used to compare the ability of these diodes in detection and mixing. Detection and mixing of M band signal were also studied by using the same group of diodes. The profile, consisting of static and dynamic characteristics, of each sample detector was obtained. From the measurement of output power versus input power, and the measurement of tangential signal sensitivity, it was determined that the comparable performance of low frequency diode extends into a higher frequency band. The computer-aided solution of three RF admittance equations simultaneously yields the values of the device parameters of the microwave diode at the operating frequencies. Dissert. Abstr.

N77-11262 Polytechnic Inst. of New York.
ADAPTIVE MESSAGE SWITCHING NETWORKS Ph.D. Thesis
Herman Frederick Haisch, Jr. 1976 250 p
Avail: Univ. Microfilms Order No. 76-23408

Present networks consist of messages switching modes interconnected by fixed capacity branches. A message enters the network at a source node and proceeds to a destination node via communication channels and intermediate nodes. At a specific node, messages arrive from incoming channels and from external sources. When a message is received its destination is determined from an address header and it is tranferred to the output branch queue corresponding to its destination. The message is transmitted to the next node along its path when the branch becomes available. Thus the channel for a particular message is a series of queues, and the message switching network is actually a network of queues. Dissert. Abstr.

N77-11263 Polytechnic Inst. of New York.
CHANNEL ASSIGNMENT IN CELLULAR MOBILE TELECOMMUNICATION SYSTEMS Ph.D. Thesis
Raymond John Pennotti 1976 365 p
Avail: Univ. Microfilms Order No. 76-23439

A cellular mobile telecommunications system uses base stations distributed throughout a metropolitan area to link mobile customers to the land telephone network. Each base is equipped with enough radios to serve customers within the area (cell) for which it is responsible. A radio channel must be assigned to each radio in the system; the same channel may be assigned to more than one radio when this will not cause undue interference. The channel assignment problem is concerned with assigning channels to the radios of a system without violating a set of interference constraints, using the fewest possible channels. This problem is posed as a graph-coloring problem and as an integer linear program. A graph theoretic model is defined which takes advantage of the cellular structure of the problem. Dissert. Abstr.

N77-11264 New Jersey Inst. of Technology, Newark.
INVESTIGATION AND OPTIMUM DESIGN OF THE GENERALIZED SECOND-ORDER PHASE-LOCKED LOOP Ph.D. Thesis
William Allen Novick 1976 401 p
Avail: Univ. Microfilms Order No. 76-23733

A second order phase locked loop (PLL) in which the loop filter contains complex zeros is investigated in both its linear and nonlinear modes of operation; prior designs used a filter containing a simple zero on the negative real axis. The basic characteristics of the generalized second order PLL operating in the linear mode including the open and closed loop responses and the corresponding root locus were generated and compared against those of the conventional second order PLL. As the conventional case, the generalized second order PLL is found to be unconditionally stable. The closed loop response of the generalized second order PLL indicates a noise bandwidth which is theoretically infinite, thus making the predetection filter critical to the performance of this PLL. Such is not the case in the conventional PLL. Dissert. Abstr.

N77-11265 Pennsylvania Univ., Philadelphia.
PHASE SCANNED ARRAY BANDWIDTH LIMITATIONS IN A WIDEBAND RADAR SYSTEM Ph.D. Thesis
David Victor Manoogian 1976 249 p
Avail: Univ. Microfilms Order No. 76-22735

Degradations in signal-to-noise ratio, range accuracy, and range resolution in a wideband radar system are studied. The degradations result from the inherent bandwidth limitation of a parallel fed phase scanned planar array antenna. A linear model of a wideband radar system is developed. It includes a transmitter, transmit planar array of arbitrary shape and amplitude taper, target, receive array antenna, receiver and envelope detector. Both pulsed cw and linear FM waveforms are considered. The impulse response function of the arbitrarily shaped transmit-receive planar array is evaluated. It is shown to be a function of the transmit and receive array amplitude tapers, the target and beam steering angular coordinates, the number of elements in the array, element spacing and radar center frequency. Dissert. Abstr.

N77-11266*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRBORNE ANTENNA POLARIZATION STUDY FOR THE MICROWAVE LANDING SYSTEM
Melvin C. Gilreath [1976] 112 p refs Original contains color illustrations
(NASA-TM-X-73952) Avail: NTIS HC A06/MF A01 CSCL 17G

The feasibility of the microwave landing system (MLS) airborne antenna pattern coverage requirements are investigated for a large commercial aircraft using a single omnidirectional antenna. Omnidirectional antennas having vertical and horizontal polarizations were evaluated at several different station locations on a one-eleventh scale model Boeing 737 aircraft. The results obtained during this experimental program are presented which include principal plane antenna patterns and complete volumetric coverage plots. Author

N77-11267*# City Coll. of the City Univ. of New York.
APPLICATIONS OF SATELLITE TECHNOLOGY FOR REGIONAL ORGANIZATIONS (PROJECT ASTRO)
Donald L. Schilling and Stanley C. Wecker Nov. 1976 225 p refs
(Grant NsG-7144)
(NASA-CR-149184) Avail: NTIS HC A10/MF A01 CSCL 17B

The direct arithmetic processing of adaptive delta modulation (ADM) encoded signals, conversion from ADM encoded signals to pulse code modulation (PCM) encoded signals, and conversion from PCM to ADM encoded signals are discussed. It is shown that signals which are ADM encoded can be arithmetically processed directly, without first decoding. Operating on the DM bit stream, and employing only standard digital hardware, the sum, difference and product can be obtained in PCM and ADM format. Author

N77-11268*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEST PROGRAM FOR TRANSMITTER EXPERIMENT PACKAGE AND HEAT PIPE SYSTEM FOR THE COMMUNICATIONS TECHNOLOGY SATELLITE
James F. DePauw, Karl E. Reader, and John V. Staskus Washington Nov. 1976 38 p refs
(NASA-TM-X-3455; E-8832) Avail: NTIS HC A03/MF A01 CSCL 17B

The test program is described for the 200 watt transmitter experiment package and the variable conductance heat pipe system which are components of the high-power transponder aboard the Communications Technology Satellite. The program includes qualification tests to demonstrate design adequacy, acceptance tests to expose latent defects in flight hardware, and development tests to integrate the components into the transponder system and to demonstrate compatibility. Author

N77-11269*# National Aeronautics and Space Administration. Pasadena Office, Calif.
THIN CONFORMAL ANTENNA ARRAY FOR MICROWAVE POWER CONVERSION Patent Application
Richard M. Dickinson, inventor (to NASA) (JPL) Filed 6 Oct.

1976 16 p
(Contract NAS7-100)
(NASA-Case-NPO-13886-1; US-Patent-Appl-SN-730045) Avail: NTIS HC A02/MF A01 CSCL 10B

A structure of a circularly polarized, thin conformal, antenna array which may be mounted integrally with the skin of an aircraft employs microstrip elliptical elements and interconnecting feed lines spaced from a circuit ground plane by a thin dielectric layer. The feed lines are impedance matched to the elliptical antenna elements by selecting a proper feedpoint inside the periphery of the elliptical antenna elements. Diodes connected between the feed lines and the ground plane rectify the microwave power, and microstrip filters (low pass) connected in series with the feed lines provide dc current to a microstrip bus. Low impedance matching strips are included between the elliptical elements and the rectifying and filtering elements.
NASA

N77-11270# Standard Electrik Lorenz A.G., Stuttgart (West Germany).
ANALYSIS OF ECONOMICS OF A TV BROADCASTING SATELLITE FOR ADDITIONAL NATIONWIDE TV PROGRAMS Final Report
Dietrich Becker, Gereon Mertens, Armin Rappold, and Wolfgang Seith Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 73 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.
(BMFT-FB-T-76-05; BMFT-NT-581) Avail: NTIS HC A04/MF A01; ZLDI, Munich, DM 15.75

The influence of a TV broadcasting satellite, transmitting four additional TV programs, on economics and development of cable TV networks was analyzed. It is assumed that the cost of the satellite systems will be financed by the cable TV system operators. The additional TV programs increase income by attracting additional subscribers. Two economic models were established: (1) each local network is regarded as an independent economic unit with individual fees (cost price model); (2) all networks are part of one public cable TV company with uniform fees (uniform price model). Assumptions are made for penetration as a function of subscription rates. Main results of the study are: the installation of a TV broadcasting satellite improves the economics of CTV-networks in both of the models; the overall coverage achievable by the uniform price model is significantly higher than that achievable by the cost price model.
Author (ESA)

N77-11271# Federal Communications Commission, Washington, D.C.
INTERFERENCE PROBLEMS ASSOCIATED WITH PROPOSED EXPANSION OF THE 27 MHz CITIZENS RADIO SERVICE BAND. PART 1: SUMMARY
Carl R. Weber and Lawrence C. Middlekamp Jun. 1976 24 p ref
(PB-254488/0; FCC/OCE/LAB-76-02-Pt-1) Avail: NTIS HC A02/MF A01 CSCL 17B

There were indications that an additional type of intermodulation (IM) interference of significant severity would occur as a result of a proposed citizens radio service (CRS) band expansion (Docket 20120). Results of laboratory measurements and field tests of this problem are presented. The Chief Engineer was advised that expansion beyond 27.405 MHz could cause certain transceivers now in use to be affected by intermodulation. These models are susceptible to IM resulting from any two signals in the band that are separated by 455 kHz in frequency. Intermodulation of this type can interfere with the reception of the desired channel to which the transceiver is tuned. GRA

N77-11272# Office of Telecommunications, Boulder, Colo. Inst. for Telecommunication Sciences.
LOCATION VARIABILITY OF TRANSMISSION LOSS: LAND MOBILE AND BROADCAST SYSTEMS
Anita G. Longley May 1976 26 p refs
(PB-254472/4; OTR-76-87) Avail: NTIS HC A03/MF A01 CSCL 17B

The results of a number of studies of path-to-path, or location, variability of transmission loss at 20 MHz to 10 GHz are summarized. It is shown that such variability appears to be normally distributed and can, therefore, be represented by a standard deviation. Location variability increases with increased frequency and terrain irregularity, the standard deviation increasing from about 5 to 25 dB. For non-urban areas an expression is given which defines location variability in terms of radio frequency and terrain irregularity. The effects of tall buildings in highly built-up urban areas, and of trees are discussed. GRA

N77-11273# Federal Communications Commission, Washington, D.C. Research and Standards Div.
MOTOR VEHICLE IGNITION RADIATION WITH RESPECT TO THE SAE STANDARD J551C
Frank Lucia, Martin Liebman, and David Desrosiers Apr. 1976 37 p
(PB-254187/8; FCC/OCE/RS76-03) Avail: NTIS HC A03/MF A01 CSCL 17B

The purpose of the project was to determine on an individual basis the percentage of vehicles in a large sample size that exceeded the Society of Automotive Engineers (SAE) J551(c) standard, and which vehicles caused degradation to land mobile reception. Ten thousand vehicles were measured at each test frequency, 50MHz and 153 MHz, as each vehicle passed the measurement site located on a single-land ramp connecting two interstate highways. Data were obtained to answer the following questions about each vehicle. (1) Was the vehicle's radiation above the industry's voluntary limit, (2) was the signal quality degraded by the vehicle's radiation, (3) how long was the degradation present, and (4)what was the make and type of the vehicle. The percentage of vehicles exceeding the SAE radiation limit was 3.6% at 50 MHz and 2.6% AT 153 MHz. All of these vehicles caused degradation of at least one quality grade to land mobile reception based on our subjective grading scale. Additionally, 16.3% of the vehicles at 50 MHz and 8.0% of the vehicles at 153 MHz caused degradation of one quality grade or more even though their radiation was below the SAE limit.
GRA

N77-11274# Booker T. Washington Foundation/Cable-Communications Resource Center, Washington, D. C.
A PRELIMINARY REVIEW OF CURRENT PRACTICES AND TRENDS IN RURAL TELECOMMUNICATIONS DEVELOPMENT AND RECOMMENDATIONS FOR FUTURE DEVELOPMENT Final Report
Aug. 1975 131 p refs
(Grant EDA-PF-487)
(PB-254366/8; EDA/OER-76-004) Avail: NTIS HC A07/MF A01 CSCL 17B

Various opinions, demonstrations, programs, and proposed pilot projects are identified which indicate that telecommunications technology can create significant impacts upon rural living conditions. The review offers insights into: (1) the type of potential impacts that telecommunications technology is expected to create in rural areas; (2) the range of present institutional and Federal interest and involvement in this area; (3) the major needs of rural areas; (4) significant pieces of proposed legislation and official Federal agency mandates which can influence the implementation of telecommunications in rural areas; (5) the thinking of informed experts on the issue of telecommunications' potential impact upon rural development; and (6) tangible recommendations that can possibly accelerate the integration of telecommunications technology into major rural economic development schemes. An extensive annotated bibliography on telecommunications and rural development is included. GRA

N77-11275# Army Electronics Command, Fort Monmouth, N.J. Avionics Lab.
DUAL BAND AIRBORNE ANTENNA TEST PROGRAM
Theodore P. Nietzold and Anthony B. Ploski, Jr. Apr. 1976 614 p
(AD-A024024; ECOM-4398) Avail: NTIS HC A99/MF A01 CSCL 09/5

Dual band antennas, operating at the C and Ku-bands with reasonable gain, good interband isolation and good radiation pattern symmetry can be fabricated for either vertical or horizontal polarization. Radiation patterns depict the expected volumetric coverage at four different locations on a UH-1 type aircraft fuselage for both vertical and horizontal polarization. GRA

N77-11276# Office of Telecommunications, Boulder, Colo.
NUMERICAL REPRESENTATION OF MONTHLY MEDIAN CRITICAL FREQUENCIES OF THE REGULAR E REGION (foE)
Margo Leftin May 1976 37 p refs
(PB-255484/8; OTR-76-88) Avail: NTIS HC A03/MF A01 CSCL 17B

Simple daytime approximations to the diurnal, seasonal, and solar activity dependence of E region critical frequencies were used to predict the propagation parameters of the E region. Frequencies, as observed by the vertical incidence ionosondes were merged with recent work on the nighttime foE to develop a numerical representation of foE continuous over the entire 24 hour period for each month at minimum and maximum solar activity levels. The use of this numerical representation is recommended whenever predictions of foE are required. Sample contour maps derived from this representation are presented. GRA

N77-11277# Army Nuclear Agency, Fort Bliss, Tex.
THE ELECTROMAGNETIC PULSE (EMP)
E. J. Gaul Jun. 1974 14 p refs
(AD-A023775; Nuclear-Notes-1) Avail: NTIS HC A02/MF A01 CSCL 18/3

One tends to think of the effects of a nuclear detonation in terms of blast, thermal radiation, and nuclear radiation. However, the one effect which may be most critical to the Army in the field is the Electromagnetic Pulse (EMP). This paper provides a survey of the EMP situation which includes defining what the phenomenon is, why it occurs, how it can damage Army equipment, and what can be done to overcome the threat. GRA

N77-11278# Magnavox-General Atronics, Philadelphia, Pa.
ADAPTIVE SAME FREQUENCY REPEATER (SFR) STUDY Final Technical Report, 16 Apr. 1974 - 15 Jul. 1975
Burton S. Abrams, Michael R. Ducoff, Samuel J. Harris, and Andrew E. Zeger Mar. 1976 132 p refs Presented at the Adaptive Antenna Workshop, 29 Oct. 1975
(Contract F30602-74-C-0242; ARPA Order 2750)
(AD-A023928; GAC-2706-2876-22; RADC-TR-76-78) Avail: NTIS HC A07/MF A01 CSCL 17/2

This report documents the technical effort on Contract F30602-74-C-0242. It presents the results of an investigation of Real time, non-sampling, Same Frequency Repeater (SFR) concepts for various types of analog and digital signals using coherent interference cancellation techniques. The report presents an analytical investigation of transmitter-to-receiver isolation achievable with a multi-channel interference cancellation system (ICS) when the repeater is used with a finitie bandwidth antenna in an environment which includes random ground clutter and specular reflectors. A design for a Same Frequency Repeater breadboard model is presented that incorporates the multi-channel interference cancellation system. The breadboard operates at 291 MHz with a bandwidth of 100 KHz and allows forward gain up to 120dB to be tested. The minimum input signal level is -90dBM, with a dynamic range of 60dB, for which the repeater will generate a 1 watt output using an AGC. Experimental results are presented which verify the design concepts on which the SFR breadboard is predicated. They also show areas where further work is needed to utilize the Full forward gain potential of the breadboard. In the present configuration, forward gains up to 67dB have been measured in the laboratory. With the incorporation of the suggested modifications, forward gain capability in excess of 102dB is anticipated. Further performance refinements may then be possible to push the forward gain capability to 120dB. A Follow-on effort for the breadboard improvement is being conducted. Results of this improvement effort will also be documented in a final technical report. Author (GRA)

N77-11279# National Science Foundation, Washington, D.C.
FEDERAL SCIENTIFIC AND TECHNICAL COMMUNICATION ACTIVITIES: 1975 Annual Progress Report, Jan. - Dec. 1975
Jun. 1976 99 p
(PB-253975/7; NSF-76-25) Avail: NTIS HC A05/MF A01 CSCL 05B

The report presents highlights of 1975 activities of over 60 Federal scientific and technical information programs in 15 executive departments and independent agencies, the Smithsonian Science Information Exchange, the Government Printing Office and the Library of Congress. The Division of Science Information, National Science Foundation, compiled the resulting descriptions and prepared a list of acronyms and abbreviations, and an index. A prefatory chapter summarizes significant developments and trends in Federal information programs. GRA

N77-11280# Army Electronics Command, Fort Monmouth, N.J.
STUDY OF THE USE OF CEFLY LANCER WIDEBAND DATA LINK EQUIPMENT FOR GUARDRAIL 2A, 4, AND 5. Final Technical Report
James E. Bartow Apr. 1976 31 p refs
(AD-A025089; ECOM-4407) Avail: NTIS HC A03/MF A01 CSCL 17/2

The use of wideband data link components used in the CEFLY LANCER air-to-ground and ground-to-air data links is studied for determination of applicability to use in the GUARDRAIL system. Among the factors considered are size, weight, cost, performance limitations, reliability, maintainability and savings through commonality. It is concluded that the use of the CEFLY LANCER J-band wideband data link equipment is feasible for GUARDRAIL and that a significant life cycle cost savings would result. Author (GRA)

N77-11281# Army Communications-Electronics Engineering Installation Agency, Fort Huachuca, Ariz.
GROUND RESISTANCE FOR MF/HF DESIGN ANALYSIS OF GROUNDED ANTENNA SYSTEMS Final Report
George Lane and Charles Masen Apr. 1976 64 p refs
(AD-A025090; EMEP-76-7) Avail: NTIS HC A04/MF A01 CSCL 09/5

A semi-empirical approach is given for calculating ground conduction losses for base-fed MF and HF antenna systems utilizing a simple ground stake or small ground screen. The method can be combined with a commonly available numerical technique for antenna modeling to obtain radiation efficiency and power gain patterns. Numerous comparisons with measured data show good agreement with the analytical approach described in this report. Author (GRA)

N77-11282# Ohio State Univ. Research Foundation, Columbus.
ANTENNA MATHEMATICAL MODELING (GTD) Final Technical Report, 1 Nov. 1974 - 31 Dec. 1975
R. G. Kouyoumjian, R. J. Luebbers, and L. Ton-That Apr. 1976 70 p refs
(Contract F30602-75-C-0051; AF Proj. 4506)
(AD-A025259; RADC-TR-76-107) Avail: NTIS HC A04/MF A01 CSCL 09/5

The primary objective of this effort has been to employ the geometrical theory of diffraction in combination with the moment method to develop a user-oriented computer code to calculate the radiation pattern of wire antennas in the presence of perturbing structures. The work accomplished can be divided into two parts. A theoretical and experimental investigation of the effect of edges on antenna input impedance and current was conducted. Then based on the results of this study, a user-oriented computer code was developed for wire antennas in the presence of a conducting surface bounded by edges, which is positioned over a reflecting surface of infinite extent. Such a configuration can be used to simulate conditions encountered in the design of antennas to meet Air Force requirements. This report describes the above work and concludes with some recommendations to improve the present code. GRA

N77-11283# Naval Postgraduate School, Monterey, Calif.
CHARGE AND CURRENT DISTRIBUTIONS ON, AND INPUT IMPEDANCE OF MODERATELY FAT TRANSMITTING CROSSED-MONOPOLE ANTENNAS Final Report, 1 Jun. 1975 - 1 Mar. 1976
Elmer J. McDowell and Robert W. Burton Mar. 1976 120 p refs
(AD-A025429; NPS-52ZN76031) Avail: NTIS HC A06/MF A01 CSCL 09/5

Charge and current distributions in the vicinity of the cross junction for several configurations of electrically long, moderately fat crossed-monopole transmitting antennas over a ground plane were measured and compared with the equivalent monopole.

The input impedance of these configurations at the ground plane/antenna interface was also experimentally determined. Junction conditions such that there would be maximum current/minimum charge and minimum current/maximum charge on the vertical monopole were examined. The effect on the input impedance and current/charge distribution of adding resonant and antiresonant horizontal cross members to the junction was investigated and displayed. For purposes of physical understanding, a zero-order explanation was given in terms of the multiple resonances present on the crossed-monopole as compared with the reference monopole. Author (GRA)

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N77-11284 Polytechnic Inst. of New York.
THE SPOT FREQUENCY DESIGN OF OPTIMUM EMBEDDING NETWORKS FOR RF SWITCHING, MODULATION, AND PHASE SHIFTING USING POWER LIMITED SWITCHES Ph.D. Thesis
Philip Silvano DiPiazza 1976 169 p
Avail: Univ. Microfilms Order No. 76-23401

A procedure is established for the spot frequency design of 2 port and 3 port switch embeddings that are optimum with respect to a given RF switching function. The results are applicable to any RF switching device that can be classified as a passive one port whose input impedance can assume either one of two steady state values, on command. The Youla-Csurgay power constraints for a two-state one-port switch were utilized as the basis for characterizing the power limitations of the device. These constraints were extended to one port switches constructed from a given configuration on n arbitrary switches. An analytical basis was established for defining an (n+1)-port embedding (for n arbitrary switches) that is optimum with respect to its equivalent figure of merit and which maximizes the total power handling capabilities of the composite structure. Dissert. Abstr.

N77-11285 Pittsburgh Univ., Pa.
TIME DOMAIN FILTERING, ESTIMATION AND PREDICTION TECHNIQUES IN POWER SYSTEMS Ph.D. Thesis
Johnnie C. Liang 1976 135 p
Avail: Univ. Microfilms Order No. 76-21791

Three problems in the monitoring and control of power systems are discussed. The matching of an arbitrary digital scanning rate to a specific slow rate central processor is examined. Optimal filters are found according to the minimum mean-square error criterion. Power system load forecasting is considered. The use of autoregressive-moving average (ARMA) model for the dynamic description of the load process is proposed for computational simplicity and accuracy in forecasting the short-term system load. The problem of power network parameter estimation is examined. Fast decoupled state-parameter estimation techniques are introduced to provide on-line capability of parameter estimation and statistically acceptable state estimator performance. Dissert. Abstr.

N77-11286 Polytechnic Inst. of New York, Farmingdale.
AN HVDC BREAKER WITH SEQUENTIAL SWITCHING Ph.D. Thesis
Kenneth Turner Lian 1976 148 p
Avail: Univ. Microfilms Order No. 76-23428

A great effort was made to determine the requirements of the system prior to adopting a device approach. This effort was complicated by the fact that when the effort began, HVDC technology was (and still is) in an embryonic stage. The key outcome of the system study was the recognition that an HVDC breaker must be fast, smart, and forgiving. The sequential switching technique for HVDC circuit breaking is the approach adopted. It employs fast mechanical switches, electronic interrupters, and energy absorbing nonlinear resistors to achieve the HVDC circuit breaker function as perceived through the system study. Functions of carrying the continuous current, interrupting the circuit current against high voltage, and absorbing the power systems energy should be performed in completely separate devices. Dissert. Abstr.

N77-11287 California Inst. of Tech., Pasadena.
DISCRETE MODELING AND ANALYSIS OF SWITCHING REGULATORS Ph.D. Thesis
Dennis John Packard 1976 171 p
Avail: Univ. Microfilms Order No. 76-23386

A simplified method for finding and using discrete small signal models for switching regulators is presented. With introduction of a new straight-line approximation, and application of root locus techniques, it is demonstrated that discrete models may be used accurately to predict wide bandwidth closed-loop behavior with methods simple enough to be useful in the initial design phase of a switching regulator. The principal result is a set of converter transfer functions comparable to the set derived by describing function techniques, but not subject to the low frequency restriction of describing function models. Also presented is a set of pulse-width modulator transfer functions which indicate that the potential small-signal transient behavior of a switching regulator is independent of the choice of modulator. Dissert. Abstr.

N77-11288 California Univ., Los Angeles.
THE DESIGN OF FILTERS TO HAVE LINEAR PASSBAND PHASE AND ARBITRARY STOPBAND LOSS Ph.D. Thesis
Donald Murray Targoff 1976 111 p
Avail: Univ. Microfilms Order No. 76-22218

A method of extending the use of the Chebyshev rational fraction to handle a design problem is described. It develops highly accurate approximate formulas for the passband envelope delay which are valid up to and including the passband edge. These formulas are analogous to those already in use for designing the stopband loss and both can easily be used together in a computer program to optimize simultaneously the stopband loss and the passband delay. This research was aimed primarily at designing filters to be realized as (nonminimum phase) lossless, reciprocal 2 ports where the complex loss poles occur in symmetric quads in the complex s-plane. The problem of finding the element values in such large networks (often of degree 40 or more) was also considered as part of this work. Dissert. Abstr.

N77-11289 Polytechnic Inst. of New York.
ROM PROGRAMMABLE CELLULAR ARRAY Ph.D. Thesis
Chung-ho Sung 1976 174 p
Avail: Univ. Microfilms Order No. 76-23451

A graphical merging technique is proposed for synthesizing a PCA using k-input, single-output ROMs. In doing so, the minterms of a given function are first converted to corresponding graphical forms, called the minigraphs. A simple merging rule is provided for merging these graphs in the same manner as two minterms are combined. A coverage map is then used to select the smallest set of graphs which realize the function F, and thus a minimal solution is obtained. An upperbound on the size of the array and the maximum number of irredundant functions realizable by a cascade structure are also provided. While the concept of graphical merger is simple for the synthesis of single-output cells, it is tedious for multi-output cells. A special decomposition technique is employed to synthesize a PCA using k-input, r-output ROMs. Several interesting properties, notably that of the equivalent forms of a cascade, are also discussed in detail. The final synthesized array is also minimal. Dissert. Abstr.

N77-11290 Syracuse Univ., N.Y.
A STUDY OF ELECTROMIGRATION IN MICROWAVE POWER TRANSISTORS Ph.D. Thesis
Donald Joseph Lacombe 1975 133 p
Avail: Univ. Microfilms Order No. 76-18531

A semiempirical theory of the electromigration process, which yields a simplified equation for the ion flux due to electromigration, has been developed. Based on this equation, an expression for the failure time of a metal stripe due to electromigration voiding was obtained. An extensive series of accelerated rf life tests was performed on a group of aluminum metalized microwave

power transistors at junction temperatures between 220 C and 310 C. Failure was found to be due, primarily, to electromigration voiding of the emitter fingers. Estimates of the mean-time-to-failure of the transistor at each temperature were obtained from the life test data. A series of dc life tests was also done on the same transistors. In these tests the dc emitter current and the temperature gradient within the transistor were approximately the same as in the rf life tests. Dissert. Abstr.

N77-11291 Lehigh Univ., Bethlehem, Pa.
PROPERTIES OF Cr-SiO2-n Si TUNNEL DIODES Ph.D. Thesis
Vikram Kumar 1976 248 p
Avail: Univ. Microfilms Order No. 76-21818

Admittance, direct current and low frequency noise of Cr-SiO2-n Si tunnel diodes have been measured at different temperatures and found to be closely correlated. Surface potential as function of bias is obtained from the measured low frequency capacitance. Surface state distribution at different temperatures is determined using the low frequency capacitance and conductance techniques. The surface state capture cross section for electrons, obtained from conductance technique, is energy dependent and decreases towards the conduction band edge. Dissert. Abstr.

N77-11292 Arizona Univ., Tucson.
TECHNIQUES FOR MODELING MULTIDIMENSIONAL EFFECTS IN INTEGRATED DEVICES Ph.D. Thesis
Jakob Hans Hohl 1976 158 p
Avail: Univ. Microfilms Order No. 76-22475

Impurity profiles, carrier distributions, and carrier flux distributions were calculated in semiconductor devices of contemporary integrated circuits. While two and three dimensional formulations are the main objectives, improved methods for calculating one dimensional distributions are also included. Successful techniques for modeling impurity profiles are analytic or semianalytic in nature, while strictly numerical algorithms prove too inaccurate or too uneconomical. The accuracy of the newly developed techniques is shown to be compatible with modern semiconductor fabrication methods. In order ultimately to obtain semiconductor device models of consistent overall accuracy and detail the effects of high impurity, concentrations were included in the analytic description of the carrier statistics. This was done without introducing major complications into the basically simple formulation. Dissert. Abstr.

N77-11293 Syracuse Univ., N.Y.
FOURIER INTEGRAL METHODS FOR STATIC AND DYNAMIC PROBLEMS IN MICROSTRIP Ph.D. Thesis
Andrew Farrar 1975 187 p
Avail: Univ. Microfilms Order No. 76-18511

A Fourier integral or k-space method is used in conjunction with the method of moments to analyze several electrostatic and time-harmonic microstrip problems. The methods are applied to compute the static capacitance matrix for multilayer multiconductor microstrip. The general formulation is developed for multilayer microstrip, and computations are carried out for covered two layer and uncovered three layer geometries. Then the methods are applied to several time harmonic microstrip problems. For open microstrip, the propagation constants for the fundamental and higher order modes are computed. Similar methods are used to compute, for purposes of comparison, the propagation constant and current distributions for the fundamental mode of stripline. In both the static and dynamic microstrip problems, improper integrals result. Several different methods of evaluation of the integrals were investigated. Dissert. Abstr.

N77-11294*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIATION FROM A CURRENT FILAMENT DRIVEN BY A TRAVELING WAVE
D. M. LeVine and Robert Meneghini Washington Oct. 1976 73 p refs
(NASA-TN-D-8302; G-76115) Avail: NTIS HC A04/MF A01 CSCL 09A

Solutions are presented for the electromagnetic fields radiated by an arbitrarily oriented current filament located above a perfectly conducting ground plane and excited by a traveling current wave. Both an approximate solution, valid in the fraunhofer region of the filament and predicting the radiation terms in the fields, and an exact solution, which predicts both near and far field components of the electromagnetic fields, are presented. Both solutions apply to current waveforms which propagate along the channel but are valid regardless of the actual waveshape. The exact solution is valid only for waves which propagate at the speed of light, and the approximate solution is formulated for arbitrary velocity of propagation. The spectrum-magnitude of the fourier transform-of the radiated fields is computed by assuming a compound exponential model for the current waveform. The effects of channel orientation and length, as well as velocity of propagation of the current waveform and location of the observer, are discussed. It is shown that both velocity of propagation and an effective channel length are important in determining the shape of the spectrum. Author

N77-11295*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESCRIPTION AND EXPECTED PERFORMANCE OF FLIGHT-MODEL, 12-GIGAHERTZ, OUTPUT STAGE TUBE FOR THE COMMUNICATIONS TECHNOLOGY SATELLITE
Gerald J. Chomos and Arthur N. Curren Washington Oct. 1976 22 p refs
(NASA-TM-X-3441; E-8777) Avail: NTIS HC A02/MF A01 CSCL 09A

The flight model output stage tube for the Communications Technology Satellite is described. The output stage tube is a 12-GHz, 200-W, coupled cavity traveling wave tube. The tube has a multistage depressed collector for efficiency enhancement. Collector cooling is accomplished by direct radiation to space. Expected rf performance and factors affecting on orbit performance and life are discussed. Author

N77-11296*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
WINDOW COMPARATOR Patent Application
James M. Black, inventor (to NASA) Filed 2 Nov. 1976 16 p
(NASA-Case-FRC-10090-1; US-Patent-Appl-SN-737974) Avail: NTIS HC A02/MF A01 CSCL 09C

A comparator comprising two operational amplifiers is described. The first has two feedback circuits, each having a diode connected to the amplifier output and poled for forward current conduction of opposite polarity, such that one diode conducts and then switches off while the other is held off and then conducts when the sign of the algebraic difference switches. Differential input terminals of the second operational amplifier are connected to the separate feedback circuits of the first operational amplifier. A selected window-width voltage is connected through a coupling resistor to one of the input terminals of the second operational amplifier to determine when the algebraic difference of the input signal and the set-point voltage has exceeded a predetermined tolerance after that difference has changed signs. Author

N77-11297# Sandia Labs., Albuquerque, N.Mex.
ELECTRICAL CHARACTERISTICS FOR RECTANGULAR CONDUCTORS
L. J. Klamerus Dec. 1975 31 p refs
(Contract AT(29-1)-789)
(SAND-75-0626) Avail: NTIS HC A03/MF A01

Four computer programs are developed to calculate inductance, capacitance, and characteristic impedance of rectangular conductor cables (shields or unshielded), stripline, and capacitors. Derivations of the inductance and capacitance equations are presented. An example is given of calculations using the computer programs, which are available in conversational mode on a time shared system for the occasional computer user. Calculated values and measurements on actual cables are calculated. ERA

N77-11298# Siemens A.G., Munich (West Germany). Werk Roehren.
NEW STORAGE TUBES Final Report
Wolfgang Welsch Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 60 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.
(BMFT-FB-T-76-02; BMFT-NT-0228) Avail: NTIS

HC A04/MF A01; ZLDI, Munich, DM 12.20

An electrical signal storage tube containing a Si-SiO2 storage target was developed. The target consists of a silicon substrate on which SiO2 stripes with a density of 660,000 stripes per cm are deposited. The image can be read out continuously for 30 min., and can be stored for about 200 days. The erase cycle takes one frame period and the limiting resolution is 9 MHz. A new direct viewing storage tube is also described. It contains an electroluminescent screen working as both a storage screen and a luminescent screen. An electron beam controls the brightness of the screen which is driven by an external ac voltage source. Unforeseen technological difficulties increased development and production costs so that the project was not finalized.

Author (ESA)

N77-11299# AEG-Telefunken, Ulm (West Germany). Fachbereich Roehren.

RAPID ELECTROGRAPHIC AND ELECTROPHOTOGRAPHIC PROCESSES. LENARD WINDOW FOR ELECTROSTATIC PRINTING TUBES Final Report

Rolf Lotthammer Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 76 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-06; BMFT-NT-289) Avail: NTIS HC A05/MF A01; ZLDI, Munich, DM 15.55

Lenard-windows consisting of plastic, metal, mica, or alumina foils for use on printing tubes, were investigated. For better mechanical stability metallic grids were used, in some cases bound to the foil. The transmission of the windows is about 50 % for 20 keV electrons. The transmitted current is amplified about 20 times by ionization in the air gap between window and paper (0.2 to 0.3 mm), reaching 50 microamps. The current is sustained by a voltage of 300 to 500 volts, causing no avalanche multiplication. Thus, a resolution of 10 1 p/mm is possible at a writing velocity of 500 m/s with an optical density smaller than 1.4 on the dielectric paper.

Author (ESA)

N77-11300# Siemens A.G., Munich (West Germany). Werk fuer Halbleiter.

NEW METHODS FOR IMPROVING THE STABILITY OF POWER DIODES Final Report

Fritz Scheidel, Klaus Bednorz, and Wilfried Anders Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-09) Avail: NTIS HC A04/MF A01; ZLDI, Munich, DM 14,50

Methods were studied for improving the stability of power diode cutoff characteristics, mechanical stability of silicon slices, and the thermal fatigue strength of soldered contacts. The application of CVD layers (prepared at temperatures from 200 to 450 C) and their passivating properties for mesa-diodes are described. Passivation by alumina silicate (SiO2 with 2% ... 5% Al2O3) can produce highly reliable diodes moulded in epoxide as has been proved by endurance tests with reverse voltage, high temperature, and high humidity. Tests are reported on the mechanical stability of silicon slices under special consideration of the influence of the different production steps. The elongation at break of silicon chips was determined in a pressure contacting system. The influence of solder compositions, soldering conditions, and diode construction on solder contact during temperature cycling was investigated. Satisfying results were achieved by lead-rich solders and by optimizing temperature-time-programs.

Author (ESA)

N77-11301# AEG-Telefunken, Ulm (West Germany). Fachbereich Roehren.

TECHNOLOGICAL STUDIES OF HIGH MISSION CURRENT DENSITY CATHODES Final Report

Franz Dlouhy Bonn Bundesmin. fuer Forsch. u. Tehcnol. Jun. 1976 127 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-10) Avail: NTIS HC A07/MF A01; ZLDI, Munich, DM 26,25

Impregnated cathodes and encapsulated heaters show no change in their initial values up to 30,000 hr life if operating conditions are suitably adjusted. Small caps of ruby, sapphire, or quartz, as well as heater encapsulation, warrant good insulation between heater and cathode up to 10,000 hr, during the operation of a 1.5 mm diameter impregnated cathode. A 2 sec heat-up-time directly heated impregnated cathode was manufactured. The operating temperature of the lanthanum hexaboride cathode was found to be too high for general use. Cold electron emitters, especially external field emitters and negative electron affinity emitters, can be applied only in limited cases on account of their strong dependence on vacuum quality and their small emitting surfaces.

Author (ESA)

N77-11302# Valvo G.m.b.H., Hamburg (West Germany). Unternehmensbereich Bauelemente.

NONVOLATILE ANALOG MEMORIES WITH FERROELECTRIC ELEMENTS Final Report

August Petersen and Fritz Schmeisser Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 134 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-11) Avail: NTIS HC A07/MF A01 ALDI, Munich, DM 27,75

The development of low cost nonvolatile ferroelectric analog memories and associated circuitry, suitable for economic storage of small quantities of information, is reported. Memory materials were investigated, and lead zirconate titanate with lanthanium doping was selected. The design and manufacturing of resonators and circuits are discussed. One of the problems identified is the compensation of the temperature coefficient of these memories, for which passive components are to be used. Applications, such as in remote control for radio and television sets, are described.

ESA

N77-11303# Siemens A.G., Munich (West Germany). Grundlagenentwicklung Halbleiter.

DESTRUCTION BY AVALANCHE BURNOUT Final Report, 1 Aug. 1973 - 31 Jul. 1975

Hansjochen Benda, Peter Huber, and Jens-Peer Stengl Bonn Bundesmin. fuer Forsch. u. Technol. Jul. 1976 45 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-14) Avail: NTIS HC A03/MF A01; ZLDI, Munich, DM 9.05

The avalanche burnout of power diodes was investigated and found to be caused in the majority of cases (50 to 75%) by inhomogeneities in the diode material; however, a physical limit for the avalanche surge capability was found which also applies in the complete absence of such inhomogeneities, namely, the occurrence of IMPATT oscillations and a resulting negative differential resistance for the slowly varying current component. Current surges of 10 microsec duration were investigated. Results agree with experience in the development of IMPATT diodes.

Author (ESA)

N77-11304# Brown, Boveri & Cie Aktiengesellschaft, Lampertheim (West Germany). Geschaeftsbereich Halbleiter- und Stromrichter.

DEVELOPMENT OF NEW ACTIVE SEMICONDUCTOR SURFACE PASSIVATION TECHNOLOGIES FOR HIGH BLOCKING VOLTAGE POWER DEVICES Final Report

Guenter Berndes and Eckhard Meyer Bonn Bundesmin. fuer Forsch. u. Technol. Jul. 1976 53 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-15) Avail: NTIS HC A04/MF A01; ZLDI, Munich, DM 10.75

A technique is described, by which fully diffused small thyristors with a 750 V blocking voltage were passivated through glazing with a lead-alumino-silicate glass powder prior to their separation into discrete chips. Metallization then ensued using chemically deposited nickel, and the specially shaped terminal contacts were soldered using a conveyer-belt oven. The maximum blocking voltage for a sine-wave application with this glass passivation technology was approximately 1200 V. The temperature limit for application appears to depend more on the quality of the surrounding assembly materials than on the start of ionic conductivity in the passivating glass. Passivation experiments with high molecular polymers showed that with special treatment junction coating resin DCR 6102 was suitable for high power devices.

Author (ESA)

N77-11305# Brown, Boveri & Cie Aktiengesellschaft, Lampertheim (West Germany). Geschaeftsbereich Halbleiter- und Stromrichter.

DEVELOPMENT OF PROCESSES FOR SIMULTANEOUS DIFFUSION OF SEVERAL DOPANT JUNCTION OR DOPING ELEMENTS FOR POWER DEVICES Final Report

Johann Arnold Becker, Harald Fischer, and Gerhard Popp Bonn Bundesmin. fuer Forsch. u. Technol. Jul. 1976 106 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-16) Avail: NTIS HC A06/MF A01; ZLDI, Munich, DM 21.85

Dopant profiles with variable characteristic data were diffused using open gallium diffusion, in which the dopant concentration was controlled by changes in the gas mixture. Two methods are described by which the dopant reaction can be controlled. Diode structures were simultaneously diffused using liquid dopants (silica films). Diodes for power applications were successfully fabricated using this method, with large penetration depths and, at the same time, with high surface concentrations at low costs and high yields. The manufacturing of lateral dopant structures for power devices, using the dopant liquids available at present, is not yet feasible since the oxide films do not mask sufficiently for the relatively long diffusion times. Author (ESA)

N77-11306# Siemens A.G., Munich (West Germany). Hauptbereich Grundlagenentwicklung.

THIN FILM CIRCUITS FOR FUTURE APPLICATIONS. PART 1: BASIC INVESTIGATIONS AND SPUTTERING TECHNIQUE Final Report

Karl-Heinz Hoppe, Wilfried Juergens, Helmold Kausche, Guenter Kiessling, Lothar Lassak, Hans Peter Lorenz, Hans Poetzlberger, Manfred Roschy, and Alois Schauer Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 175 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-20) Avail: NTIS HC A08/MF A01; ZLDI, Munich, DM 36.35

The development of passive networks using the thin film technique was studied, with special emphasis on sputtered tantalum film based resistor and capacitor networks. Investigations in ultrahigh vacuum showed that chromiumoxide causes the negative resistance temperature coefficient of NiCr films. The nonlinearity of film resistors is explained solely by their TCR. Resistors with definite TCR and high quality capacitors were developed on the basis of Ta thin films. The search for new materials led to AlTa films. The latter made a new RC network technology possible. Experiments were carried out with the electrodeless plasma ring discharge in order to sputter films in large quantities. Author (ESA)

N77-11307# Siemens A.G., Munich (West Germany). Hauptbereich Grundlagenentwicklung.

THIN FILM CIRCUITS FOR FUTURE APPLICATIONS. PART 2: EVAPORATION TECHNIQUE Final Report

Guenter Haug, Karl-Heinz Houska, Hans-Josef Schmidt, Heinz-Peter Sprengel, and Kurt Wohak Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 107 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol. (BMFT-FB-T-76-21) Avail: NTIS HC A06/MF A01; ZLDI, Munich, DM 22.05

Investigations of thin film diffusion processes and reactions with encapsulation materials resulted in improved long term stability of evaporated NiCr resistors, SiO capacitors, and NiCr/Au conductors for thin film circuits. Stable NiCr resistor networks can be formed on ceramic substrates and SiO capacitors of good quality can be deposited on the new very smooth ceramic substrates. The knowledge of the influence of evaporation parameters makes the production of SiO capacitors with definite properties and good reproducibility possible. The range of capacitance of tantalum thin film circuits can be extended by integration with evaporated SiO capacitors. Author (ESA)

N77-11308# Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.

INTERMODULATION STUDY Interim Report, Jul. - Dec. 1974

Otto Sauseng Griffiss, AFB, N. Y. RADC Mar. 1976 98 p refs

(Contract F30602-74-C-0304; AF Proj. 5573)

(AD-A023906; RADC-TR-76-6) Avail: NTIS HC A05/MF A01 CSCL 09/1

Possible methods for reducing capture effects and intermodulation distortion in broadband traveling-wave tubes were investigated theoretically. Considered were techniques internal to the TWT, that involve interaction of electron beam and slow wave circuit. In particular, simultaneous interaction in both the fundamental and the harmonic frequency range was studied for possible reduction of intermodulation distortion. Several schemes of harmonic interaction were investigated; these included harmonic fast space charge wave interaction with harmonic loss, harmonic slow space charge wave interaction with and without harmonic loss, harmonic phase tapering and harmonic drive. Of these, the last method, using simultaneous harmonic signal injection, was found to be the most promising for significantly reducing intermodulation distortion while maintaining high levels of efficiency. GRA

N77-11309# Raytheon Co., Waltham, Mass. Special Microwave Devices.

MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING HIGH EFFICIENCY HIGH POWER GALLIUM ARSENIDE READ-TYPE IMPATT DIODES Quarterly Report, 1 Oct. - 31 Dec. 1975

H. R. Chalifour and S. R. Steele 31 Dec. 1975 105 p

(Contract DAAB07-75-C-0045)

(AD-A023913; Rept-0276-1211; QR-2) Avail: NTIS HC A06/MF A01 CSCL 09/1

Procedures have been developed for the complete evaluation of gallium arsenide wafers beginning at wafer growth up to final evaluation of finished diodes fabricated from the wafers. The system allows traceability of final data back to the original location or site in the epitaxial reactor. Using the system, evaluation results are presented for wafers processed during the period. Some of the wafers processed exhibit good uniformity of characteristics. The first operating life test has been completed. GRA

N77-11310# Army Electronics Command, Fort Monmouth, N.J.

A NEW CERAMIC FLAT PACK FOR QUARTZ RESONATORS

P. D. Wilcox, G. S. Snow, and E. Hafner Apr. 1976 32 p refs Submitted for publication

(DA Proj. 1S7-62705-AH-94)

(AD-A024074; ECOM-4396) Avail: NTIS HC A03/MF A04 CSCL 09/1

The performance of quartz resonators is strongly dependent on the method of packaging. The stringent performance requirements imposed by moddern communication and navigation systems has necessitated the development of a family of microcircuit compatible quartz crystal units for which a new flat package configuration, a ceramic material, a new sealing technique, and novel mounting methods will be used. This report discusses the criteria used to arrive at the new package design. The package consists of a frame with a top and bottom lid. The frame is constructed by a multilayer ceramic technique, with buried layer metallization for the electrical connections. The ceramic currently being used is Al_2O_3 and the feedthrough metallization is tungsten. The package has low capacitance. GRA

N77-11311# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.

ADVANCED CONCEPTS OF MICROWAVE GENERATION AND CONTROL IN SOLIDS Technical Report, 1 May - 31 Oct. 1975

G. C. Dalman, L. F. Eastman, C. A. Lee, and Jeffrey Frey Mar. 1976 218 p refs

(Contract F30602-74-C-0001; AF Proj. 5573)

(AD-A023950; RADC-TR-76-63) Avail: NTIS HC A10/MF A01 CSCL 09/1

This report describes the research accomplished during the fourth biannual period of a three year research program dealing with advanced concepts of microwave generation and control in solids. The emphasis of the program is to examine the optimum design and operation of microwave solid state devices for practical

applications and to conduct related semiconductor material research. Work was conducted in the following areas: avalanche transit-time devices and related research; transferred electron devices and related research; and microwave field-effect transistors. The report contains a summary of the work accomplished during the half year period of research. The topics discussed are: GaAs Read Diodes; IMPATT Characteristics; Measurement of IMPATT Diode Amplifier Parameters; Computer Experiments on TRAPATT Circuits; High Power, High Efficiency CW TEO's Compound Semiconductor Transistor Study; Automated Measurement of FET S-Parameter; The Epitaxial Growth of Thin GaAs Layers; Read Structures; and Electric-Current-Controlled LPE Growth of GaAs. Author (GRA)

N77-11312# Naval Civil Engineering Lab., Port Hueneme, Calif.
STRESS ANALYSIS OF NAVY VLF ANTENNA INSULATORS Final Report, Jul. 1974 - Jun. 1975
G. E. Warren Apr. 1976 38 p refs
(YF53534011)
(AD-A024054; CEL-TR-839) Avail: NTIS HC A03/MF A01 CSCL 09/1

The stresses in high-voltage porcelain insulators that support as well as insulate Navy VLF communication antenna towers up to 1,500 feet (460 meters) in height were photoelastically studied. These insulators have been plagued with structural and electrical problems since installation. Therefore, the Navy has begun a program to install insulators entailing new design configurations. The objective of this stress analysis program was (1) to analyze the old insulators using photoelastic coatings applied before removal of the tower load in an attempt to correlate the electrical problems with structural weaknesses, and (2) to predict the structural behavior of the new insulator configurations using three-dimensional photoelasticity with finite element theory comparison. The insulator problems, modeling techniques, as well as stress behavior of the structural models, are given.
Author (GRA)

N77-11313# TRW, Inc., Lawndale, Calif. Semiconductor Div.
TOP COLLECTOR CONTACTED MICROWAVE POWER TRANSISTOR; MONOLITHIC MICROWAVE LUMPED ELEMENT INTEGRATED CIRCUIT PROGRAM, PHASE 1 Final Report, 1 Jan. - 17 Dec. 1975
Al Harrington, George Schreyer, and Jim Steenbergen Jan. 1976 142 p refs
(Contract N00014-75-C-0405)
(AD-A023829) Avail: NTIS HC A08/MF A01 CSCL 09/1

The objective of the contract is to investigate the monolithic integrated circuit approach for the fabrication of RF power transistors and associated matching networks to eliminate hand working, wire bonding and to provide improved uniformity, yield, reliability and ultimately, lower cost. Specifically, Phase I of this work calls for an all top contacted 30 watt, 1.0 to 1.5 GHz power transistor. The devices meet or exceed all the contract requirements (30 watt at 1.5 GHz with 7dB gain). The final processes used and the best results are discussed. Also discussed is the processing of the monolithic matching networks. A process has been developed to process the networks that is compatible with the device processing. The losses in the networks are approximately equal to the presently used lumped element networks. The final process and test results are discussed. GRA

N77-11314# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE DETECTION CAPABILITIES OF GALLIUM ARSENIDE AND S-20 PHOTO-MULTIPLIER TUBES TO GO-TYPE, POINT-SOURCE, SIGNALS
Robert Weber 3 Mar. 1976 25 p refs
(Contract F19628-76-C-0002; AF Proj. 2128)
(AD-A023818; TN-1976-13; ESD-TR-76-61) Avail: NTIS HC A02/MF A01 CSCL 09/1

The GO-type, point-source detection capabilities of typical, available, GaAs and S-20 photo-multiplier tubes are calculated at + or - 20 C for systems employing telescope apertures ranging from 2.5 in. to 48 in., for four decades of sampling rates, for night-sky brightnesses of 22m to 17m per sq arc sec, and primarily for a signal-to-noise ratio of six and a field-of-view of 30 arc sec x 30 arc sec. In certain special instances, other ratios and fields are considered. The results indicate the superiority 0.7H - 5.0 visual magnitudes of detectability) of the cooled GaAs tube over the S-20 tube under the conditions considered. The detailed results and comparisons are presented in the form of a series of tables. Author (GRA)

N77-11315# Brush Wellman, Inc., Cleveland, Ohio.
PRODUCTION ENGINEERING MEASURES TO MANUFACTURE SUPER FINE FINISH BERYLLIA Quarterly Progress Report, 1 Jan. - 31 Mar. 1976
Glenn H. Rees 10 Apr. 1976 35 p refs
(Contract DAAB07-74-C-0606)
(AD-A024470; BW-TR-576; QPR-6) Avail: NTIS HC A03/MF A01 CSCL 09/1

Progressive polishing of beryllia substrates was demonstrated on manufacturing scale equipment. Working surfaces with 2 to 3 microinches smoothness were produced. The input substrates were commercially available 99.5% BeO parts of 1 in x 1 in and 2 in x 2 in dimensions. The physical, electrical, and thermal properties met or exceeded the modified specification requirements. Author (GRA)

N77-11316# State Univ. of New York, Buffalo.
SUSCEPTIBILITY OF UHF RF TRANSISTORS TO HIGH POWER UHF SIGNALS, PART 2 Final Report, Jul. 1973 - Dec. 1974
Hollis J. Hewitt, R. Alan Blore, and James J. Whalen Apr. 1976 75 p refs
(Contract F30602-75-C-0122; AF Proj. 9567)
(AD-A024394; RADC-TR-76-44-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 09/1

A program is described which was initiated to determine what effects high power UHF/microwave signals have upon solid state components, such as transistors used in RF amplifier stages of high power receivers. The electromagnetic vulnerability (EMV) data needed involves determining the effects of high power 240 MHz RF microsecond single pulse signals upon those transistors Testing was performed using 2N5179 and 2N918 transistors. A study was made to determine the incident pulse powers required to cause a 50% failure rate. The data suggests that UHF receivers with an RF transistor amplifier front end may be as susceptible to intense electromagnetic radiation (EMR) at UHF frequencies as those with a mixer diode front end. Physical analysis of the 2N5179 transistor revealed emitter-base shorting at the silicon-oxide interface as the primary failure site. This was found to be dependent upon the absorbed energy. Collector-base degradation was found to be dependent upon absorbed power. Optical and scanning electron photomicrographs of some of the failed devices are included. Author

N77-11317# Systems Science and Software, Hayward, Calif.
REPETITIVELY PULSED COLD CATHODE STUDIES Interim Technical Report, 8 Apr. 1974 - 30 Mar. 1975
Dec. 1975 96 p
(Contract DAAH01-74-C-0624)
(AD-A024354; SSS-75-264) Avail: NTIS HC A05/MF A01 CSCL 09/1

The objectives of this research effort, to determine the operational characteristics of high repetitive rate cold cathode electron guns and use the data in the conceptual design of an example system, have been achieved. All performance characteristics required for the conceptual device have been demonstrated with an experimental electron gun. This laboratory device is full scale in all of its important dimensions. The data are therefore directly applicable to the conceptual design of an example system. GRA

N77-11318# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
DEVELOPMENT OF ELECTRONIC CIRCUITS FOR ADVANCED HIGH TEMPERATURE FIRE DETECTORS Final Report, 1 Jul. 1973 - 30 Jun. 1975
D. G. Fox Mar. 1976 42 p refs
(AF Proj. 3048)
(AD-A023843; AFAPL-TR-75-111) Avail: NTIS HC A03/MF A01 CSCL 13/12

This program was directed toward developing electronic circuits for advanced high temperature infrared and ultraviolet fire detectors which had been developed by the laboratory. A circuit which is applicable to any gas discharge type of UV

sensor performed satisfactorily; however, the high temperature UV sensor did not perform reliably above 600F. A circuit for a 750F infrared fire detector was developed and performed satisfactorily. The circuit uses the flicker phenomenon of fuel type fires to distinguish the fire from background sources. This circuit is applicable to any similar solid state infrared sensor.

GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N77-11319 Massachusetts Univ., Amherst.
LOW REYNOLDS NUMBER ENTRANCE FLOWS: A STUDY OF A MOTIONLESS MIXER Ph.D. Thesis
Thomas Tan Tung 1976 229 p
Avail: Univ. Microfilms Order No. 76-22306

The particular device used is a Kenics static mixer which is an alternating series of left and right-hand helical elements enclosed by a tubular housing. The mixing action is caused by diverting the flow field through the arrangement of the helical elements which not only partition the pipe into two 180 deg twisted semicircular sections but also have 90 deg phase difference between adjacent elements. A nonorthogonal helical coordinate system was constructed to describe the geometry of the mixer. The conservation equations of mass, momentum and energy are derived in the coordinate system. A steady helical velocity profile in the mixer was obtained by solving the conservation equations in the helical system with the assumption that the dominant velocity is in the direction of the helical path and that the effects of thickness of the helical element and the entrance flow are negligible. Dissert. Abstr.

N77-11320 Oregon State Univ., Corvallis.
DISCRETE MODELING OF FLOW SYSTEMS Ph.D. Thesis
Feg-Wen Chang 1976 117 p
Avail: Univ. Microfilms Order No. 76-23507

A stirred tank network model (continuous time compartment model) is summarized and then compared with the discrete flow model. Both models make use of fractional input matrix with elements representing the fraction of flow into the jth region which originates in the ith region. It is shown that the discrete flow model is more general and computationally much simpler than the stirred tank network model. The fractional input matrix is used to find the sizes of the regions, to predict the residence time distribution of the fluid in flow systems, and to compute the conversion for chemical reaction occurring in a flow system. Direct methods for finding the fractional input matrix from either steady state or transient data are developed, and methods and problems of fitting the model to data are presented. Dissert. Abstr.

N77-11321 Princeton Univ., N.J.
AN EXPERIMENTAL STUDY OF COMPRESSIBLE TURBULENT BOUNDARY LAYER SEPARATION AT HIGH REYNOLDS NUMBERS Ph.D. Thesis
Gary Stuart Settles 1976 179 p
Avail: Univ. Microfilms Order No. 76-22625

Compressible turbulent boundary layer separation at two dimensional ramp and axisymmetric flare compression corners was studied at a Mach number varying between values of 1.4 x 100,000 and 7.6 x 1 million. Incipient and small separation phenomena were investigated. An experimental flowfield model was developed for a separated compression corner interaction at a high Reynolds number. The experiments were performed in a unique wind tunnel facility which permits the independent variation of the length and density terms on the Reynolds number. Results indicate that the incipient separation phenomenon has a gradual nature rather than the abrupt nature usually ascribed to it. Dissert. Abstr.

N77-11322 Rice Univ., Houston, Tex.
A HYDRODYNAMIC STABILITY ANALYSIS OF SOME PROPOSED MODEL EQUATIONS FOR BIOFLUIDS Ph.D. Thesis
James Michael Hutfilz 1976 223 p
Avail: Univ. Microfilms Order No. 76-21683

Nonlinear hydrodynamic stability analysis is used to analyze the response of a chemically reactive fluid to finite amplitude perturbations. The constitutive equation used consists of that of an incompressible Newtonian fluid with an added active stress term. This added term represents a coupling of concentration and temperature gradients in the stress tensor. This constitutive relation was proposed in an attempt to describe the protoplasm of living cells. The system is analyzed for both zero and first order reaction kinetics. Three basic problems are considered: (1) active stress with no body force term, (2) active stress with a gravitational body force, and (3) a gravitational body force with no active stress term. The relevant dimensionless groups in these problems are an active stress number, the heat and mass Grashof numbers, the Prandtl number, and the Schmidt number. Dissert. Abstr.

N77-11323 Syracuse Univ., N.Y.
THE PERMEATION OF GASES THROUGH POLYETHYLENE MEMBRANES AT HIGH PRESSURES. A FREE-VOLUME MODEL OF PERMEATION Ph.D. Thesis
Shou-mean Fang 1975 200 p
Avail: Univ. Microfilms Order No. 76-18509

The rates of permeation of helium, nitrogen, carbon dioxide, nitrous oxide, methane, ethane, ethylene, propane, fluoroform, and 1,1-difluoroethylene through low density polyethylene membranes were measured in the temperature range from -18 C to 50 C, and at pressure differences across the membranes of up to 70 atm. In a different set of experiments, the solubility of nitrogen, carbon dioxide, ethylene, fluoroform, and 1,1,-difluoroethylene in low-density polyethylene was measured in the temperature range from 0 C to 50 C, and at pressures of up to 50 atm. Mean permeability coefficients and solubility coefficients were determined from these measurements. Dissert. Abstr.

N77-11324 Colorado Univ., Boulder.
THEORY OF SHOCK STRUCTURE IN A MAXWELL GAS BASED ON THE CHAPMAN-ENSKOG DEVELOPMENT THROUGH SUPER-SUPER-BURNETT ORDER Ph.D. Thesis
Charles Evans Simon 1976 151 p
Avail: Univ. Microfilms Order No. 76-23681

This is a theoretical investigation of the structure of a normal shock wave in a gas composed of Maxwell molecules. The higher order gas dynamic differential equations for the shock structure through Super-Super-Burnet order are derived from the Boltzmann equation using a simplified version of the well known Chapman-Enskog development. Perturbation methods are used to find approximate solutions for the Super-Burnett and Super-Super-Burnett equations, which are not amenable to numerical integration by conventional techniques. The perturbation methods are shown to produce satisfactory approximate solutions for the Navier-Stokes and Burnett equations, which are amenable to numerical integration. The higher order gas dynamic corrections to the Navier-Stokes density profile for a Maxwell gas are shown to be qualitatively similar to the discrepancies between experimental results and the Navier-Stokes density profile for a realistic intermolecular potential. Dissert. Abstr.

N77-11325 Rice Univ., Houston, Tex.
DYNAMIC BEHAVIOR OF FLUID-TANK SYSTEMS Ph.D. Thesis
Jong Yih Yang 1976 214 p
Avail: Univ. Microfilms Order No. 76-21727

Hydrodynamic forces were induced in fluid-filled storage tanks subjected to earthquake excitation and of the free vibration of the coupled fluid-tank systems. Throughout this study, the fluid is assumed to be incompressible and inviscid. The first part deals with the hydrodynamic forces induced in a rigid tank subjected to a lateral earthquake excitation. In the second part, an approximate analysis is presented for the hydrodynamic forces induced in flexible fluid-filled tanks. The tank is assumed to

vibrate in a prescribed mode and the cross section of the tank is presumed to remain circular during vibration. The third part deals with the free vibrational characteristics of flexible circular cylindrical tanks. Both empty tanks and tanks filled with liquid are considered. The fourth part deals with the axisymmetric free vibration of fluid-tank systems. Dissert. Abstr.

N77-11326 Princeton Univ., N.J.
DEVELOPMENT OF THE ELECTRON BEAM FLUORESCENCE TECHNIQUE FOR MEASUREMENTS IN A HYPERSONIC TURBULENT FLOW Ph.D. Thesis
James Francis Driscoll 1975 99 p
Avail: Univ. Microfilms Order No. 76-22594

The purpose was to establish the electron beam fluorescence technique as a means of measuring the mean and fluctuating components of density and temperature, as well as other thermodynamic variables, in compressible turbulent flows. Because of the limitations of present probes, there exists a scarcity of reliable statistical data describing turbulent phenomena in compressible flows. Mean and fluctuating components of local gas density and temperature can be obtained using the electron beam fluorescence technique in compressible turbulent flow without resorting to flow field or small perturbation assumptions. Simultaneous measurements were made of two spectral lines in the fluorescent spectra of helium, at 5016A and 3965A. Dissert. Abstr.

N77-11327 Georgia Inst. of Tech., Atlanta.
CHEMICALLY REACTING FLOWS IN POROUS MEDIA Ph.D. Thesis
Allen Charles Merritt 1976 187 p
Avail: Univ. Microfilms Order No. 76-23300

The domains of chemical vapor deposition in the industrial process of pack cementation were studied. A comprehensive analytical model describing simultaneous transport phenomena in porous media is developed. Distinction is made between consolidated and unconsolidated media. Particular attention was paid to the models which described specific aspects of transport phenomena in porous media. The specific problem in pack cementation chosen for study is the hydrogen reduction of HSiCl3 to produce a silicon coating on an inert substrate. The substrate is also the wall of the pack cementation container. The generalized porous media transport equations are tailored to meet the constraints of the specific pack process chosen. These equations are then solved as an initial value problem through standard numerical techniques on a CDC digital computer. Special boundary conditions and transport properties in the vicinity of the wall are developed. Dissert. Abstr.

N77-11328 New Jersey Inst. of Technology, Newark.
SEPARATIONS OF MULTICOMPONENT MIXTURES VIA THERMAL PARAMETRIC PUMPING Ph.D. Thesis
John Daniel Stokes 1976 256 p
Avail: Univ. Microfilms Order No. 76-23734

Dilute solution separations were predicted from existing binary equations by assuming the existence of pseudo binary systems, each system consisting of one solute and the common solvent. Two systems, toluene-aniline-n-heptane and toluene-acetophenone-n-heptane with a silica gel adsorbent were used to experimentally demonstrate the separation. Experimental results were in good agreement with the mathematical predictions. The dilute solution (pseudo binary) theory was used to develop design equations for pilot plant and commercial systems. The parametric pumping assembly has the configuration of a multi-tube heat exchanger due to the necessity of instantaneous temperature changes between the hot and cold half-cycles. In addition to the main assembly, the requirements for auxiliary tanks, pumps, and instrumentation are outlined along with a process description for the operation of the entire system. Dissert. Abstr.

N77-11329 South Carolina Univ., Columbia.
HYDRODYNAMIC ASPECTS OF THE CRITICAL HEAT FLUX IN SUBCOOLED CONVECTION BOILING Ph.D. Thesis
Eric John Thorgerson 1969 203 p
Avail: Univ. Microfilms Order No. 76-21905

Two hydrodynamic models of subcooled convection boiling burnout are studied and tested. One model is based on the concept of a critical two phase boundary thickness at burnout. The other model is based on the boundary layer separation under the influence of mass injection from the wall as developed by Kutateladze. An experimental program was conducted to determine the effect of hot spots on subcooled flow boiling burnout. The critical heat flux is related to the friction factor through Reynolds analogy between momentum and heat transport, demonstrating that the heat transfer mechanism near the critical condition is limited by turbulent convection. It is also shown that the void fraction in high subcooling, i.e., T sub greater than 45 F, burnout is very low. Furthermore, pressure drop for the same condition is due almost entirely to friction effects. The boundary layer separation mechanism is found to compare favorably with results in the low subcooling region. Dissert. Abstr.

N77-11330 Polytechnic Inst. of New York.
ORBITAL MOTION OF DIPOLES IN ELECTROMAGNETIC FIELDS Ph.D. Thesis
Paul Melman 1976 93 p
Avail: Univ. Microfilms Order No. 76-23434

As a highly accurate model of a particle with magnetic moment, the Dirac equation for an electron in a pure magnetic field was used. In this case the Dirac equation may be transformed exactly into the Foldy-Wouthuysen representation. Using the transformed Hamiltonian, the Heisenberg equations of motion were derived. The results obtained exhibit in a transparent way and a feature which is the inclusion of the magnetic orientation energy in the inertial mass of an electron. In addition, the gyromagnetic ratio is modified by a factor of the rest mass divided by the modified mass. This result differs significantly from the results of the classical relativistic theory in which the inertial mass of a particle includes the kinetic energy only. A different method to obtain a classical limit from a quantum theory is by asymptotic expansion of the wave function. Dissert. Abstr.

N77-11331 Georgia Inst. of Tech., Atlanta.
MAXWELL YIELDS BOLTZMANN t YIELDS INFINITY Ph.D. Thesis
Joel Lamar Davis, Jr. 1976 106 p
Avail: Univ. Microfilms Order No. 76-22375

Exact results are obtained for the time evolution of the phase space distribution in several specific situations. The tools of operator calculus are applied to the Liouville equation and the time evolution of the system calculated for a noninteracting, ideal gas, an ideal gas interacting with an external potential, and an ideal gas interacting with an external potential and immersed in a Brownian fluid. In the first two cases equilibrium is reached by the contracted, spatial distribution which is obtained by integrating the full phase space distribution with respect to its momentum variables. It is shown that, if the initial distribution is Maxwellian in momentum, the contracted, spatial distribution for the first system becomes a uniform distribution while, for the second system, the contracted, spatial distribution goes to an equilibrium which is not a Boltzmann distribution although it has something of a Boltzmann character. In the case of the third system, the phase space distribution is shown to go to a Maxwell-Boltzmann distribution. Dissert. Abstr.

N77-11332 Lehigh Univ., Bethlehem, Pa.
A STUDY OF INTERNAL FORCED CONVECTIVE BOILING HEAT TRANSFER FOR BINARY MIXTURES Ph.D. Thesis
Douglas Leslie Bennett 1976 198 p
Avail: Univ. Microfilms Order No. 76-21804

Over 1,100 data points for internal forced convective boiling heat transfer are reported. Most of these data were taken in the annular flow regimes. The fluids tested were distilled water, ethylene glycol and aqueous mixtures of ethylene glycol. The experimental data indicates the following: (1) a previously unrecognized Prandtl number effect for both pure components and mixtures; (2) a mixture effect associated with the microscopic heat transfer mechanism; and (3) a mixture effect associated with the macroscopic heat transfer mechanism. An expression is developed which correlates the experimental data to within a mean deviation of 14.9%. A modified Reynolds analogy is used which accounts for the Prandtl number effect. It is postulated that the mixture effects observed for this study are due to local composition profiles in the liquid, near the evaporating layer. Dissert. Abstr.

N77-11333 Polytechnic Inst. of New York.
THERMAL BOUNDARY LAYER FLOW OF ABSORBING AND EMITTING HIGH TEMPERATURE AIR Ph.D. Thesis
Leon Lung-chen Chen 1976 107 p
Avail: Univ. Microfilms Order No. 76-23398

An analysis was made to determine the effect of variable fluid properties and thermal radiation to laminar thermal boundary layer flow of absorbing and emitting high temperature air. The physical model considered is a parallel, uniform, steady, laminar flow of high temperature air at a constant temperature of 20,000 K passing over an isothermal semi-infinite flat plate. The flat plate is assumed black surface and is kept at a constant temperature of 2,000 K. The laminar boundary layer momentum and energy equations are transformed by Levy Lees transformation variables amd solved by the implicit finite difference method using an efficient block tridiagonal factorization technique.
Dissert. Abstr.

N77-11334 Polytechnic Inst. of New York.
A COMPOSITE TRANSER MATRIX-SYNTHESIS APPROACH TO PIPING DYNAMIC ANALYSIS Ph.D. Thesis
Paul Bezler 1976 246 p
Avail: Univ. Microfilms Order No. 76-23394

The transfer matrix method is used to determine the dynamic characteristics of simple configurations considered to represent typical piping components. The developed data, tabular listings of transfer matrix state vectors, include sufficient information to delineate the first five natural frequencies and their associated deflection and force mode shapes for five fixed components configurations over a range of their span length parameters. These data will define the dynamic characteristics of any three span configuration likely to occur in piping runs. Used with the fixed constraint modal synthesis method, they permit the ready analysis of the most generalized piping systems, specific examples of applications to typical piping configurations, both simple and branched, with an assessment of technique accuracy are included.
Dissert. Abstr.

N77-11335 Houston Univ., Tex.
MATHEMATICAL MODELLING FOR AN UNSTEADY VERTICALLY STRATIFIED FLOW FIELD Ph.D Thesis
James Chien-I Chang 1976 106 p
Avail: Univ. Microfilms Order No. 76-21859

The development of a mathematical model to simulate an unsteady stratified flow field by utilizing the momentum equation, the continuity equation, and the mass transport equation as the governing equations of the model is described. This model is developed based on a hypothetical river estuary system consisting of a main channel and a branch channel. The unsteady flow is simulated by a tidal motion as one of the boundary conditions and the suspended sediment concentration is utilized as an indicator of stratification. The total depth of water of the model channel system is divided into layers of equal thickness. The model first calculates the hydrodynamic characteristics of each layer of the river estuary. Then by utilizing the information from the hydrodynamic calculation, it computes the transport of suspended sediment in each layer.
Dissert. Abstr.

N77-11336 Marquette Univ., Milwaukee, Wis.
AN EXPERIMENTAL AND ANALYTICAL STUDY OF THE SPUTTERING PHENOMENA Ph.D. Thesis
Paul Allen Howard 1975 173 p
Avail: Univ. Microfilms Order No. 76-21747

One form of the sputtering phenomena that heat transfer process occurs when an initially hot vertical surface is cooled by falling liquid film, was examined. The sputtering front is the lowest wetted position on the vertical surface and is characterized by a short region of intense nucleate boiling. Heat transfer is of current interest in the analysis of some of the performance aspects of light water reactor emergency core cooling systems. An experimental apparatus was constructed which enabled the detailed examination of the heat transfer characteristics of a sputtering front. A heat source of sufficient intensity was located immediately below the sputtering front which prevented its downward progress thus permitting detailed steady state surface temperature measurements throughout a sputtering front.
Dissert. Abstr.

N77-11337 Polytechnic Inst. of New York.
EXPERIMENTAL INVESTIGATION OF COAXIAL TURBULENT JETS Ph.D. Thesis
Jonathan Alan Bornstein 1976 138 p
Avail: Univ. Microfilms Order No. 76-23395

The application of optical diagnostic techniques for the experimental analysis of turbulent flowfields was investigated. Raman Scattering and Laser Doppler Velocimetry were utilized to determine temperature, specie concentration, and velocity information for an isothermal coaxial jet and an unpremixed methane-air flame. Comparison of these results with those of more conventional methods such as hot-wire anemometry, thermocouples, and gas chromatography was very good, indicating that the optical techniques are superior since they do not require the insertion of a probe which will perturb the flowfield.
Dissert. Abstr.

N77-11338 Polytechnic Inst. of New York, Brooklyn.
A GENERAL FORMULATION AND SOME APPROXIMATE METHODS FOR MULTI-DIMENSIONAL NONGRAY RADIATIVE TRANSFER Ph.D. Thesis
Sen-sung Tsai 1976 137 p
Avail: Univ. Microfilms Order No. 76-23454

In terms of the total band absorption, a general formulation of the radiative heat flux and its divergence for absorbing-emitting nongray gases with multidimensional arbitrary configurations is presented. It is applicable to general boundary conditions, such as black bounding walls, diffuse walls and specified intensity of radiation at transparent bounding walls. Some approximate solution methods are provided which can considerably reduce the mathematical complexity associated with nongray radiative problems. The spectral intensity of radiation is solved from the radiative transfer equation and then substituted into the defining equations of the radiative heat flux and its divergence. This results in complicated expressions in terms of the spectral absorption coefficient and the spectral Planck function, involving integrations with respect to frequency, spatial coordinate and solid angle.
Dissert. Abstr.

N77-11339*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SYSTEMATIC STUDY OF ERROR SOURCES IN SUPERSONIC SKIN-FRICTION BALANCE MEASUREMENTS
Jerry M. Allen Washington Oct. 1976 52 p refs
(NASA-TN-D-8291; L-10619) Avail: NTIS HC A04/MF A01 CSCL 20D

An experimental study was performed to investigate potential error sources in data obtained with a self-nulling, moment-measuring, skin-friction balance. The balance was installed in the sidewall of a supersonic wind tunnel, and independent measurements of the three forces contributing to the balance output (skin friction, lip force, and off-center normal force) were made for a range of gap size and element protrusion. The relatively good agreement between the balance data and the sum of these three independently measured forces validated the three-term model used. No advantage to a small gap size was found; in fact, the larger gaps were preferable. Perfect element alignment with the surrounding test surface resulted in very small balance errors. However, if small protrusion errors are unavoidable, no advantage was found in having the element slightly below the surrounding test surface rather than above it.
Author

N77-11340*# New Mexico Univ., Albuquerque. Dept. of Mechanical Engineering.
INVESTIGATION OF PERFORMANCE LIMITS IN AXIAL GROOVE HEAT PIPES Final Report
K. Thomas Feldman Jul. 1976 42 p refs
(Grant NsG-2064)
(NASA-CR-137912; UNM-TR-ME-70(76)NASA-365-1) Avail: NTIS HC A03/MF A01 CSCL 20D

The entrainment-shear performance limit which occurs in axial groove heat pipes was investigated and explained. In the existing heat pipe literature the entrainment heat flux limit is defined as the condition where the Weber number is greater than or equal to one. In this analysis, the critical value for the entrainment Weber number is found to be 2 pi less than or equal to 3 pi. Perhaps more important to the heat pipe designer than the entrainment performance limit is the prediction of the

performance degradation due to vapor-liquid shearing stress which is also described. Preliminary qualitative experiments were conducted to observe the shear. stress wave formation phenomena. The equations presented may be used to predict and minimize the vapor-liquid shear stress performance effects that occur in axial groove and puddle flow artery heat pipes. Author

N77-11341# Mitsubishi Electric Mfg. Co. Ltd., Amagasaki (Japan).

LOCAL TEMPERATURES IN SEMIGRAY NONDIFFUSE CONES AND V-GROOVES

Sadao Shimojo 18 Nov. 1976 38 p refs Backup document for AIAA synoptic scheduled for publication in AIAA Journal, Feb. 1977

Avail: NTIS HC A03/MF A01

The kernel of integral equations for radiant fluxes takes infinitely large values at the apex of a conical cavity and a V groove cavity, and generally at the intersection of plates, too. It is found that the kernel behaves the same as the Dirac's delta function at the apex and intersection of plates. Therefore, the extreme temperature in the corresponding configuration can be exactly estimated. Utilizing the estimated value, the radiosity integral equations for semigray surfaces are solved numerically over the cavity. The results and analysis of the features of the temperature distribution give a measure for estimating the extreme values and a guide for the thermal design of cavity configurations in cooperation with the results of the nodal analysis. Author

N77-11342*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NUMERICAL SOLUTION OF SUPERSONIC THREE-DIMENSIONAL FREE-MIXING FLOWS USING THE PARABOLIC-ELLIPTIC NAVIER-STOKES EQUATIONS

Richard S. Hirsh Washington Nov. 1976 63 p refs (NASA-TN-D-8195; L-10750) Avail: NTIS HC A04/MF A01 CSCL 20D

A numerical method is presented for solving the parabolic-elliptic Navier-Stokes equations. The solution procedure is applied to three-dimensional supersonic laminar jet flow issuing parallel with a supersonic free stream. A coordinate transformation is introduced which maps the boundaries at infinity into a finite computational domain in order to eliminate difficulties associated with the imposition of free-stream boundary conditions. Results are presented for an approximate circular jet, a square jet, varying aspect ratio rectangular jets, and interacting square jets. The solution behavior varies from axisymmetric to nearly two-dimensional in character. For cases where comparisons of the present results with those obtained from shear layer calculations could be made, agreement was good. Author

N77-11343*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EVALUATION OF MEAN AND TURBULENT VELOCITY MEASUREMENTS IN SUBSONIC ACCELERATED BOUNDARY LAYERS

V. A. Sandborn (Colo. State Univ.) and H. L. Seegmiller Washington Nov. 1976 44 p refs (NASA-TN-D-8367; A-6278) Avail: NTIS HC A03/MF A01 CSCL 20D

Exploratory measurements of the mean and turbulent flow in the wall boundary layer of a 15.2- by 10.2-cm channel were obtained as part of an instrumentation development program for measurements in compressible flow. Mean surface and flow field surveys were obtained at channel Mach numbers ranging from 0.2 to 0.9. The mean velocity distributions were obtained with total pressure probes and a laser velocimeter. At a channel Mach number of 0.2, several types of hot-wire probes were used to obtain both velocity fluctuations and Reynolds shear-stress results. Author

N77-11344*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE EIGENVALUE SPECTRUM OF THE ORR-SOMMERFELD PROBLEM

Basil N. Antar Washington Oct. 1976 45 p refs Sponsored in part by the Natl. Acad. of Sciences/Natl. Res. Council (NASA-TR-R-469; M-188) Avail: NTIS HC A03/MF A01 CSCL 20D

A numerical investigation of the temporal eigenvalue spectrum of the ORR-Sommerfeld equation is presented. Two flow profiles are studied, the plane Poiseuille flow profile and the Blasius boundary layer (parallel): flow profile. In both cases a portion of the complex c-plane bounded by 0 less than or equal to CR sub r 1 and -1 less than or equal to ci sub i 0 is searched and the eigenvalues within it are identified. The spectra for the plane Poiseuille flow at alpha = 1.0 and R = 100, 1000, 6000, and 10000 are determined and compared with existing results where possible. The spectrum for the Blasius boundary layer flow at alpha = 0.308 and R = 998 was found to be infinite and discrete. Other spectra for the Blasius boundary layer at various Reynolds numbers seem to confirm this result. The eigenmodes belonging to these spectra were located and discussed. Author

N77-11345*# United Technologies Research Center, East Hartford, Conn.

THE INVISCID PRESSURE FIELD ON THE TIP OF A SEMI-INFINITE WING AND ITS APPLICATION TO THE FORMATION OF A TIP VORTEX Final Report

G. F. Hall, S. J. Shamroth, H. McDonald, and W. R. Briley Washington NASA Oct. 1976 84 p refs (Contract NAS1-12794) (NASA-CR-2748; Rept-36.300) Avail: NTIS HC A05/MF A01 CSCL 01A

A method was developed for determining the aerodynamic loads on the tip of an infinitely thin, swept, cambered semi-infinite wing at an angle of attack which is operating subsonically in an inviscid medium and is subjected to a sinusoidal gust. Under the assumption of linearized aerodynamics, the loads on the tip are obtained by superposition of the steady aerodynamic results for angle of attack and camber, and the unsteady results for the response to the sinusoidal gust. The near field disturbance pressures in the fluid surrounding the tip are obtained by assuming a dipole representation for the loading on the tip and calculating the pressures accordingly. The near field pressures are used to drive a reduced form of the Navier-Stokes equations which yield the tip vortex formation. The combined viscid-inviscid analysis is applied to determining the pressures and examining the vortex rollup in the vicinity of an unswept, uncambered wing moving steadily at a Mach number of 0.2 at an angle of attack of 0.1 rad. The viscous tip flow calculation shows features expected in the tip flow such as the qualitatively proper development of boundary layers on both the upper and lower airfoil surfaces. In addition, application of the viscous solution leads to the generation of a circular type flow pattern above the airfoil suction surface. Author

N77-11346*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A DEVICE FOR RAPID DETERMINATION OF THERMOPHYSICAL PROPERTIES OF PHASE-CHANGE WIND-TUNNEL MODELS

Theodore R. Creel, Jr. Washington Nov. 1976 23 p refs (NASA-TM-X-3421; L-10832) Avail: NTIS HC A02/MF A01 CSCL 20D

An experimental method for direct measurement of the thermophysical properties of wind tunnel heat transfer models was developed. The technique consists of placing the model under a bank of high intensity, radiant heaters so that the fast opening water cooled shutters, which isolate the heater bank from the model, allow a step-input heat rate to be applied. Measurements of the heat transfer rate coupled with a surface-temperature time history of the same material are sufficient to determine the material thermophysical properties. An infrared thermometer is used to measure model surface temperature and a slug calorimeter provides heat transfer rate information. The output from the infrared thermometer and calorimeter is then fed into an analog-to-digital converter which provides digitized data to a computer. This computer then calculates combined thermophysical properties and a teleprinter prints out all the data. Thus, results are available within 7 minutes of test initiation as opposed to the weeks or months required using prior techniques. Author

N77-11347# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).

THE KNUDSEN FLOW BETWEEN OBLIQUE PLATES Ph.D.

Thesis - Goettingen Univ., West Ger. [DIE KNUDSEN-STROEMUNG ZWISCHEN SCHRAEG STEHENDEN PLATTEN]
Diethard Gerhold Jan. 1976 63 p refs In GERMAN
(Rept-1/1976) Avail: NTIS HC A04/MF A01; Max-Planck-Inst. fuer Stroemungsforsch., Goettingen, West Ger. DM 16,50

The Boltzmann equation and partition function of a Knudsen gas were derived. The collision density function is dealt with in detail: the integral equation, the asymptotes, the exponent S and the factor A of the asymptote, the case of convergent flow, and the approximation formula for the transition probability. The energy flow density and the impulse exchange are discussed. Calculation of the convergence of the Neumann series is annexed. ESA

N77-11348# National Aerospace Lab., Amsterdam (Netherlands). Scientific Services Div.
TWO DIMENSIONAL MHD DUCT FLOW: NUMERICAL ANALYSIS AND MEASUREMENTS
H. Snel, J. P. F. Lindhout, W. Merck (Eindhoven Univ. of Technol., Neth.), and J. Houben (Eindhoven Univ. of Technol., Neth.) 11 Apr. 1975 19 p refs Presented at the 6th Intern. Conf. on MHD Elec. Power Generation, Washington, D.C., 9-13 Jun. 1975
(NLR-MP-75016-U) Avail: NTIS HC A02/MF A01

The problem dealt with is that of the turbulent compressible flow between the insulator walls of an MHD duct, for which a set of equations is derived, accounting for turbulent transport phenomena, nonequilibrium ionization, and ambipolar diffusion. The equations are solved with a finite difference method of second order accuracy in both directions. A transformation of the coordinate perpendicular to the wall accounts for the large gradients close to the wall. Still, special attention had to be given to higher order derivates in the wall region to get around singular behavior problems. The streamwise pressure gradient dp/dx is found as a part of the solution of the gasdynamic quantities. The electromagnetic quantities are not actually found from a full solution of the electronic equations but from the experimental values and empirical relations worked out by Brederlow which, together with two-dimensional current-potential calculations, give information on the Hall-component of the current density in Ohm's law. The numerical calculations show good agreement with a series of measurements made by Merck at the 200 kW plasma jet MHD test rig of the Max Planck Institute for Plasmaphysics in Garching. Author (ESA)

N77-11349# Institut Franco-Allemand de Recherches, St. Louis (France).
NEW APPLICATIONS OF LASER ANEMOMETRY TO TURBULENT FLOW [NOUVELLES APPLICATIONS DE L'ANEMOMETRIE LASER AUX ECOULEMENTS TURBULENTS]
X. Bouis and J. P. Hancy 10 Oct. 1975 34 p refs In FRENCH Presented at the 12th Colloq. Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(ISL-CO-212/75) Avail: NTIS HC A03/MF A01

The principles of laser anemometry are reviewed. The instruments developed and experience gained with turbulent flow have increased the accuracy of velocity measurement using particles as tracing elements. It is shown that the addition to the measuring instruments of Bragg cells and a computer for data acquisition allows investigation of the turbulence and noise parameters. Emphasis is laid on the performance of this method when applied to hot fluids, combustion, transonic flow, and acoustic problems, for those cases in which the flow may not be perturbed. ESA

N77-11350# Leybold-Heraeus G.m.b.H., Cologne (West Germany). Abt. WVT 51.
LOW TEMPERATURE HEAT EXCHANGERS Final Report
Manfred Wittig Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 30 p ref In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.
(BMFT-FB-T-76-07) Avail: NTIS HC A03/MF A01; ZLDI, Munich, DM 5.90

Effective low temperature heat exchangers were developed for a temperature range from 10 mK to 4.2 K. The design, operation, and efficiency of silver net, sinter metal, and ribbed pipe heat exchangers are described, as well as the test results obtained in He-3/He-4 dilution refrigerators. Author (ESA)

N77-11351# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
VISCOUS FLOW AT THE BOUNDARY OF A POROUS MATERIAL
Vivian O'Brien Sep. 1975 47 p refs
(Contract N00017-72-C-4401)
(AD-A022715; APL-JHU-TG-1285) Avail: NTIS HC A03/MF A01 CSCL 20/4

The boundary region between an open viscous flow and a porous matrix has been examined for parallel flow by numerical solution of the viscous flow equations. Results for simple shear flow are consistent with analytic theory and experimental results on a slotted disk(Richardson-Taylor model). Results for pressure-driven flow are new. The variation of the slip velocity at the boundary plane with geometric parameters is illustrated, and its prediction via 'slip coefficients' is discussed. GRA

N77-11352# National Aerospace Lab., Amsterdam (Netherlands).
COMPARISON OF DATA FROM TWO SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTION EXPERIMENTS Final Report, 1 Jan. 1975 - 1 Jan. 1976
R. J. Vidal (Calspan Corp., Buffalo, N. Y.) and J. W. Kooi Jan. 1976 25 p refs
(Contract AF-AFOSR-2815-75; AF Proj. 9767)
(AD-A024520; NLR-AC-76-02; EOARD-TR-76-002) Avail: NTIS HC A02/MF A01 CSCL 20/4

The data from two shock wave turbulent boundary layer interaction experiments are compared. In both experiments a normal shock interacted with a two-dimensional turbulent boundary layer in a uniform flow with a Mach number of 1.4. One test was performed in the Ludwieg Tube of Calspan Corporation and the other in the NLR supersonic blow-down wind tunnel. The general set up of the experiments and the models used were quite similar. The only differences were model dimensions, unit Reynolds number and type of windtunnel. The comparison includes wall pressure, the initial boundary layer and static pressure normal to the plate. The wall pressure distributions of both experiments, scaled with a reference length which is a function of the Reynolds number, correlate very well. There is no indication of any influence of model characteristics on the supersonic part of the pressure distribution. In the NLR experiment the skin friction was calculated with the aid of Clauser plots whereas in the Calspan experiment the skin friction was measured with skin friction transducers. Using one set of data the results of both techniques are compared. Author (GRA)

N77-11353# Naval Research Lab., Washington, D.C.
ADDED MASS AND DAMPING FORCES ON CIRCULAR CYLINDERS Final Report
R. A. Skop, S. E. Ramberg, and K. M. Ferber 19 Mar. 1976 21 p refs
(AD-A024037; NRL-7970) Avail: NTIS HC A02/MF A01 CSCL 20/4

Results of experiments to determine the fluid loadings on harmonically oscillating circular cylinders show that the inertial (added mass) component of the loading is in good agreement with the inertial loading predicted by potential flow theory. The results show, however, that the commonly used velocity-squared law for damping is inadequate. In fact, experiments indicate that fluid damping is sensibly viscous (linear) for vibration amplitudes up to 0.8 diameter peak-to-peak and is a combination of viscous and velocity-squared damping at larger amplitudes. This new damping law has important implications for the design of offshore structures. Author (GRA)

N77-11354*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STRUCTURE OF TWO-DIMENSIONAL TURBULENT WALL-JETS IN THE PRESENCE OF ADVERSE PRESSURE GRADIENTS Final Technical Report, Mar. 1974 - Jun. 1975
Demosthenes Papailiou Jun. 1975 77 p refs
(Contract NAS7-100; AF Proj. 7116)
(NASA-CR-149126; AD-A023955; ARL-TR-75-0218) Avail: NTIS HC A05/MF A01 CSCL 20/4

The mechanism by which wall jets prevent boundary layer

separation and diffuser stall has been experimentally examined. Mean velocity profiles and turbulence statistics in both the separated and jet-energized boundary layer have been measured in the presence of a coflowing stream and adverse pressure gradients. Some preliminary conclusions are suggested.
Author (GRA)

N77-11355# RAND Corp., Santa Monica, Calif.
THE EFFECTS OF WALL TEMPERATURE AND SUCTION ON LAMINAR BOUNDARY-LAYER STABILITY
W. S. King Apr. 1976 27 p refs Sponsored by DARPA (Contract DAHC15-73-C-0181)
(AD-A025337; R-1863-ARPA) Avail: NTIS HC A03/MF A01 CSCL 20/4

An integral solution of the two-dimensional boundary-layer equations for water with pressure gradient, heat transfer, and suction was employed to investigate laminar boundary-layer stability. It was shown that the effects of suction, wall heating, and pressure gradient on critical Reynolds numbers could be correlated as a function of universal boundary-layer parameters. It was indicated that suction is the most effective and pressure gradient the least effective means to stabilize a boundary layer. However, the effectiveness of suction is enhanced by a favorable pressure gradient. GRA

N77-11356# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
ANALYSIS AND DESIGN OF EJECTOR DIFFUSER FOR OPTIMUM THRUST
Tsze C. Tai Mar. 1976 29 p refs Presented at Navy Symp. on Aeroballistics (10th), Fredericksburg, Va., 15-17 Jul. 1975
(AD-A025491; AERO-1214) Avail: NTIS HC A03/MF A01 CSCL 21/5

Recent advances in jet ejectors operating under static conditions have produced high thrust augmentation that is feasible for application to V/STOL flight. However, because of (a) loss in augmentation in duct flow, (b) ramjet effect, and (c) space limitations, high performance and compactness are required in the design of thrust-augmenting ejectors for V/STOL aircraft. An analytical inverse approach is presented in which the pressure distribution along the diffuser wall of an ejector is defined for a given entrance flow condition and the contour of the desired diffuser wall is determined by using a finite difference technique. The prescribed pressure distribution is first optimized by a modified Stratford criterion for incipient separation of turbulent boundary layers; this optimization makes it applicable to compressible two-dimensional and axisymmetric flows. GRA

N77-11357# Advisory Group for Aerospace Research and Development, Paris (France).
FLUID DYNAMICS PANEL SYMPOSIUM ON FLOW SEPARATION
D. J. Peake (NAE, Ottawa) and W. J. Rainbird (Carleton Univ.) Oct. 1976 18 p refs
(AGARD-AR-98) Avail: NTIS HC A02/MF A01

This report contains an evaluation and appraisal of the subject with recommendations for future research. Current knowledge and understanding of the fluid physics of 2D and 3D flow separation and reattachment, particularly for turbulent flows, is limited. It is necessary that high quality, carefully planned 2D and 3D boundary layer experiments be conducted to obtain dependable experimental data to enhance our basic knowledge, and for use in verification, validation and development of theoretical prediction methods. These complete, unambiguous data sets should include detailed documentation of all measurable quantities, both mean and fluctuating at the wall, in the viscous boundary layer and in the external flowfield. Emphasis should be placed on redundant measurement techniques to ensure high data reliability. Author

N77-11226# Royal Aircraft Establishment, Bedford (England).
THE APPLICATION OF A LASER ANEMOMETER TO THE INVESTIGATION OF SHOCK-WAVE BOUNDARY-LAYER INTERACTIONS
I. F. East *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 10 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11230# California Inst. of Tech., Pasadena. Dept. of Aeronautics.
SINGLE SCATTERING PARTICLE LASER DOPPLER MEASUREMENTS OF TURBULENCE
Paul E. Dimotakis *In* AGARD Appl. of Non-Instrusive Instr. in Fluid Flow Res. May 1976 14 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11232# Edinburgh Univ. (Scotland).
MEASUREMENT OF PERIODIC FLOWS USING LASER DOPPLER CORRELATION TECHNIQUES
F. H. Barnes, Q. I. Daudpota, T. S. Durrani (Southhampton Univ., Engl.), I. Grant (Napier Coll. of Tech., Edinburgh, Scotland), and C. A. Greated *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 10 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11233# George Washington Univ., Washington, D.C. School of Engineering and Applied Sciences.
OPTICAL MEASUREMENTS OF THERMODYNAMIC PROPERTIES IN FLOW FIELDS. A REVIEW
R. Goulard *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 18 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11235# Institut Franco-Allemand de Recherches, St. Louis (France).
LOCAL MEASUREMENT AND PROPORTIONAL DENSITY OF GASEOUS FLOW BY RAMAN ANTI-STOKES COHERENT SCATTERING [MESURE LOCALE ET CONTINUE DE LA DENSITE D'UN ECOULEMENT GAZEUX PAR DIFFUSION COHERENTE RAMAN ANTI-STOKES]
A. Hirth *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 7 p refs In FRENCH; ENGLISH summary (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11238# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CHARACTERIZATION OF NOISE SOURCES IN HOT JETS BY THE CROSSED BEAM TECHNIQUE [CARACTERISATION DES SOURCES DE BRUIT DANS LES JETS CHAUDS PAR LA TECHNIQUE DES FAISCEAUX CROISES]
Mariano Perulli, Jean-Francois DeBelleval, and Jean Maulard *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p refs In FRENCH; ENGLISH summary (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N77-11358 Polytechnic Inst. of New York.
RESONANT PRESSURE INSTRUMENTATION Ph.D. Thesis
George Martin Schuster 1976 225 p
Avail: Univ. Microfilms Order No. 76-23445

Analytical techniques were developed which can be usefully applied to the design and calibration of resonant pressure transducers, with emphasis on those instruments which use an elastic resonator as the basic sensor. It is shown how pressure-frequency relations may be developed for distributed resonators, both by direct solution of linear differential equations and by approximation methods for nonlinear cases. These relations are useful in establishing the operating frequency range and pressure

sensitivity as functions of resonator dimensions and elastic properties, so that different resonator configurations may be compared. Near resonance, each distributed resonator can be represented by a second order linear dynamical system with lumped parameters. Dissert. Abstr.

N77-11359 Tennessee Technological Univ., Cookeville.
ON THE CONVECTION LIMITED SELF-SUSTAINED ACOUSTIC VIBRATIONS IN A CLOSED CYLINDRICAL CHAMBER Ph.D. Thesis
Jih-Chin Fang 1975 236 p
Avail: Univ. Microfilms Order No. 76-22002

The heat transfer rate from a constant-temperature hot wire and the vaporization rate of a liquid droplet of propellant in a rocket engine are both convection limited; therefore, a system using a hot-wire transducer as an analog of a liquid droplet of propellant was developed and used to simulate the coupling of the combustion process with the gasdynamics in liquid-propellant rocket engines. It was assumed that the combustion process was vaporization-limited and that the combustion chamber was acoustically similar to a closed-closed right-circular cylinder. The analog system was then employed to investigate the ingredients of acoustic instability of liquid propellant rocket engines. Dissert. Abstr.

N77-11360 Missouri Univ., Columbia.
A NEW TECHNIQUE FOR MEASURING DOPPLER EFFECT Ph.D. Thesis
Subin Banharnsupavat 1975 110 p
Avail: Univ. Microfilms Order No. 76-21989

A technique for measuring the Doppler effect was developed; the method comprised the use of a piezoelectric transducer coupled to a target foil to induce motion in the target atoms. Preliminary measurements using a thin Cd foil together with a diffractometer indicated that the method was feasible. Subsequently, the total cross section of U-238 was measured by the time-of-flight method using the ORELA 20 meter station. Data were taken at target temperatures of 138 K and 293 K both with the target foil stationary and vibrating. An x-cut quartz crystal vibrating at 88 kHz was used and the energy range from 3.75 to 39.60 ev was covered. The results for the 6.67 ev resonance were obtained for both target temperatures; the expected broadening of the resonance was observed when the target was vibrated. An asymmetry observed in the broadened resonance was tentatively attributed to the phonon distribution. Dissert. Abstr.

N77-11361 New Jersey Inst. of Technology, Newark.
THE EFFECTS OF OPTIMAL PATH PERTUBATIONS DURING RECORDING ON A RECONSTRUCTED HOLOGRAPHIC IMAGE Ph.D. Thesis
Stevan Israel Feldman 1976 219 p
Avail: Univ. Microfilms Order No. 76-23731

The theory concerning the effects of object motion alone on the radiance distribution of a reconstructed holographic image is extended. Experimental verification of the theory is presented for the cases of step object motion, step film motion, simultaneous step film and object motion, simultaneous staircase film and object motion, and simultaneous step film staircase motion. Holographic recording conditions under which a step change in refractive index occurs in a slab of the medium separating the mechanically stationary object and film during the hologram recording are analyzed. It is shown that, within the assumptions of paraxial conditions and small optical path perturbations, these conditions are equivalent to the occurrence of a mechanical step film motion during the hologram recording. Extension of this interpretation and of the resulting analysis technique to the study of the effects of turbulence in the optical path medium during recording on the reconstructed holographic image yields results in accordance with the predictions of conventional turbulence analysis techniques. Dissert. Abstr.

N77-11362*# Arizona Univ., Tucson. Steward Observatory.
EVALUATION OF A LARGE FORMAT IMAGE TUBE CAMERA FOR THE SHUTTLE SORTIE MISSION Final Report
W. C. Tifft Jun. 1976 45 p refs
(Grant NsG-7142)
(NASA-CR-149093; A-76-11) Avail: NTIS HC A03/MF A01 CSCL 14E

A large format image tube camera of a type under consideration for use on the Space Shuttle Sortie Missions is evaluated. The evaluation covers the following subjects: (1) resolving power of the system (2) geometrical characteristics of the system (distortion etc.) (3) linear characteristics of the fiber optic coupling (4) background effects in the tube (5) uniformity of response of the tube (as a function of wavelength) (6) detective quantum efficiency of the system (7) astronomical applications of the system. It must be noted that many of these characteristics are quantitatively unique to the particular tube under discussion and serve primarily to suggest what is possible with this type of tube. Author

N77-11363*# National Aeronautics and Space Administration. Pasadena Office, Calif.
DIFFERENTIAL OPTOACOUSTIC ABSORPTION DETECTOR Patent Application
Michael S. Shumate, inventor (to NASA) (JPL) Filed 27 Aug. 1976 18 p
(Contract NAS7-100)
(NASA-Case-NPO-13759-1; US-Patent-Appl-SN-718266) Avail: NTIS HC A02/MF A01 CSCL 14B

A differential optoacoustic absorption detector employs two tapered cells in tandem or in parallel. When operating in tandem, two mirrors are used at one end remote from the source of the beam of light directed into one cell back through the other, and a lens to focus the light beam into the one cell at a principal focus half way between the reflecting mirrors. Each cell is tapered to conform to the shape of the beam so that the volume of one is the same as for the other, and the volume of each receives maximum illumination. The axes of the cells are placed as close to each other as possible in order to connect a differential pressure detector to the cells with connecting passages of minimum length. An alternative arrangement employs a beam splitter and two lenses to operate the cells in parallel. NASA

N77-11364*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANGLE DETECTOR Patent Application
Gilbert T. Parra, inventor (to NASA) Filed 10 Nov. 1976 16 p
(NASA-Case-ARC-11036-1; US-Patent-Appl-SN-740457) Avail: NTIS HC A02/MF A01 CSCL 14B

An angle detector for determining a transducer's angular disposition to a capacitive pickup element is described. The transducer comprises a pendulum mounted inductive element moving past the capacitive pickup element. The capacitive pickup element divides the inductive element into two parts L sub 1 and L sub 2 which form the arms of one side of an a-c bridge. Two networks R sub 1 and R sub 2 having a plurality of binary weighted resistors and an equal number of digitally controlled switches for removing resistors from the networks form the arms of the other side of the a-c bridge. A binary counter, controlled by a phase detector, balances the bridge by adjusting the resistance of R sub 1 and R sub 2. The binary output of the counter is representative of the angle. NASA

N77-11365*# California Univ., Los Angeles. Mechanics and Structures Dept.
HOLOGRAPHIC FLOW VISUALIZATION Final Report
A. F. Charwat and M. E. Fourney Nov. 1976 47 p refs
(Grant NsG-268)
(NASA-CR-149182; UCLA-ENG-76105) Avail: NTIS HC A03/MF A01 CSCL 14E

Holographic visualization techniques are presented of the vortex wake of a lifting wing. The motions of tracer particles in vortical flows are described along with the development of a liquid-drop tracer generator. An analysis is presented of the motion of particles of arbitrary density and size in solid body and potential vortex flows. M.C.F.

N77-11366*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SCANNING RADIOMETER FOR MEASUREMENT OF FORWARD-SCATTERED LIGHT TO DETERMINE MEAN DIAMETER OF SPRAY PARTICLES
Donald R. Buchele Washington Nov. 1976 18 p refs
(NASA-TM-X-3454; E-8816) Avail: NTIS HC A02/MF A01 CSCL 14B

A scanning radiometer is reported that measures forward-scattered light to determine the mean diameter of spray particles. An optical scanning method gives a continuous measurement of the light-scattering angle during spray nozzle tests. A method of calibration and a correction for background light are presented. Mean particle diameters of 10 to 500 micrometers can be measured. Author

N77-11367*# National Bureau of Standards, Washington, D.C. Electronic Technology Div.

DEVELOPMENT OF DYNAMIC CALIBRATION METHODS FOR POGO PRESSURE TRANSDUCERS

John S. Hilten, Paul S. Lederer, Carol F. Vezzetti, and J. Franklin Mayo-Wells Nov. 1976 56 p refs
(NASA Order H-92100A)
(NASA-CR-149193; NBS-TN-927) Avail: NTIS MF A01; available from SOD as C13.46:927, HC $1.15 CSCL 14B

Two dynamic pressure sources are described for the calibration of pogo pressure transducers used to measure oscillatory pressures generated in the propulsion system of the space shuttle. Rotation of a mercury-filled tube in a vertical plane at frequencies below 5 Hz generates sinusoidal pressures up to 48 kPa, peak-to-peak; vibrating the same mercury-filled tube sinusoidally in the vertical plane extends the frequency response from 5 Hz to 100 Hz at pressures up to 140 kPa, peak-to-peak. The sinusoidal pressure fluctuations can be generated by both methods in the presence of high pressures (bias) up to 55 MPa. Calibration procedures are given in detail for the use of both sources. The dynamic performance of selected transducers was evaluated using these procedures; the results of these calibrations are presented. Calibrations made with the two sources near 5 Hz agree to within 3% of each other. Author

N77-11368# Institut Franco-Allemand de Recherches, St. Louis (France).

INTERFEROMETRY OF TRANSIENT PHENOMENA USING LASERS EMITTING AT DIFFERENT WAVELENGTHS IN THE UV, VISIBLE, AND INFRARED SPECTRAL RANGE

M. Hugenschmidt and K. Vollrath 6 Sep. 1974 27 p refs
(ISL-36/74) HC A03/MF A01

Optical interferometric methods using lasers provide interesting possibilities for quantitative analysis of objects with small absorption in the range of both experimental gas-dynamics and plasma-physics. The first investigations were performed with solid-state lasers, especially ruby lasers. With these lasers short pulses in the nano- and pico-second range with peak powers of several MW to GW can be obtained. Two-wavelength-interferometry applied to conventional or holographic techniques gives a marked increase of information as compared to purely monochromatic or even white-light sources. Further increase of sensitivity, in investigating for sample plasmas of low electron densities, is possible by the application of lasers emitting in the infrared. The use of CO2-lasers necessitates a study of new detection systems as conventional photographic materials are not available. The methods of the above mentioned different experimental procedures and the possibilities for quantitative explorations are discussed. Author (ESA)

N77-11369# Institut Franco-Allemand de Recherches, St. Louis (France).

SOME PROPERTIES OF SOURCES USED IN HYPERVELOCITY HOLOGRAPHY [QUELQUES PROPRIETES DES SOURCES POUR L'HOLOGRAPHIE RAPIDE]

Hubert Fagot 8 Dec. 1975 9 p refs In FRENCH Presented at the ANRT Colloq. on l'Eclairage en Cinema Rapide, Paris, 18-19 Nov. 1975
(ISL-CO-217/75) Avail: NTIS HC A02/MF A01

Some properties of coherent light sources to be used in high speed holography are reviewed. They include the time and spatial coherence and short impulse. The application of ruby lasers to high speed holography is described. Some results emphasizing the possibilities of ruby lasers when applied to scattering object holography (single exposure technique) and holographic interferometry (double exposure technique) are discussed. ESA

N77-11370# Institut Franco-Allemand de Recherches, St. Louis (France).

LASER ANEMOMETRY AND DISPLACEMENT OF THE MEASUREMENT POINT IN INDUSTRIAL WIND TUNNELS Final Report [VELOCIMETRIE LASER ET DISPLACEMENT DU POINT DE MESURE EN SOUFFLERIE INDUSTRIELLE]

X. Bouis and J. P. Hancy 21 Apr. 1975 31 p refs In FRENCH
(Contract STAe-74/98018)
(ISL-R-116/75) Avail: NTIS HC A03/MF A01

A lightweight, portable, and compact system for the displacement of the measurement point of a laser anemometer was realized. This system developed in a false backscattering configuration is able to scan a 30 cm x 15 cm domain in either the vertical or horizontal plane, with 30 cm displacement per min by 1 cm steps which can be fractioned into 0.02 mm steps. Principles of laser anemometry, its cost, and its interest in aerodynamic studies are reviewed. Principles of the false backscattering are presented and the experimental design described. Laser anemometry applications to some French industrial wind tunnels such as S3 Modane, Sigma 4, and S10-CEAT are discussed. Future work on laser anemometry applications to turbulent flow in the S10-CEAT wind tunnel is recommended. ESA

N77-11371# Institut Franco-Allemand de Recherches, St. Louis (France).

COMPARISON OF INSTANTANEOUS VELOCITY MEASUREMENTS BY HOT-WIRE ANEMOMETRY AND LASER ANEMOMETRY [COMPARAISON DES MESURES DE VITESSE INSTANTANEE FAITES PAR ANEMOMETRE A FIL CHAUD ET ANEMOMETRE LASER]

J. Haertig, G. Koerber, and X. Bouis 14 May 1975 22 p refs In FRENCH
(ISL-R-117/75) Avail: NTIS HC A02/MF A01

Results of velocity measurements by laser anemometry and hot-wire anemometry were compared to evaluate the accuracy of both methods. Both methods are described and applied to the investigation of cold free jets propagating with an 80 m/s velocity from an 80 mm nozzle. The hot-wire anemometer signal was processed simultaneously with the laser anemometer measurement of flow particle velocity. The precision of the instantaneous velocity value was evaluated. Various sources of errors were examined. They include hot-wire anemometer response to thermal and aerodynamic excitations, delay between particle speed and fluid velocity, and dimensions and respective positions of measuring instrumentation. The suitability of laser anemometry application to transonic turbulent jet flow is evidenced. ESA

N77-11372# Institut Franco-Allemand de Recherches, St. Louis (France).

POLYCHROMATIC LIGHT HOLOGRAPHY [HOLOGRAPHIE EN LUMIERE POLYCHROMATIQUE]

H. Royer 20 Aug. 1975 18 p refs In FRENCH
(ISL-R-124/75) Avail: NTIS HC A02/MF A01

Various problems related to the recording and restitution of holographic images in polychromatic light are discussed. They include the recording mounting, the vibration of holograms, and the gelatin contraction. Holograms restituting images with the same color as the originals were obtained. The method is simple and can be applied to microholography in order to restitute images without aberrations. ESA

N77-11373# Institut Franco-Allemand de Recherches, St. Louis (France).

DATA ACQUISITION AND PROCESSING SYSTEM FOR SPECTRAL ANALYSIS OF THE TEMPORAL VELOCITY VARIATIONS IN A GAS FLOW [DATENERFASSUNGS- UND -VERARBEITUNGSSYSTEM ZUR SPEKTRALANALYSE DER ZEITLICHEN GESCHWINDIGKEITSSCHWANKUNGEN IN EINER GASSTROEMUNG]

H. J. Pfeifer 30 Sep. 1975 31 p refs In GERMAN
(ISL-R-127/75) Avail: NTIS HC A03/MF A01

A data acquisition and processing system is described which enables determination of the power spectral density of velocity variations in a gas flow with laser anemometry methods. Two single systems working at low data rate with high precision are used for data acquisition. Data processing is handled by a

minicomputer. Several tests were carried out to determine the properties of the overall system. ESA

N77-11374# Institut Franco-Allemand de Recherches, St. Louis (France).

COMPARISON OF LASER ANEMOMETRY METHODS OF SEVERAL LABORATORIES. REPORT ON ISL MEASUREMENTS CARRIED OUT 5 - 8 NOVEMBER 1974 [VERGLEICH LASERANEMOMETRISCHER VERFAHREN VERSCHIEDENER LABORATORIEN. BERICHT UEBER DIE VOM 5. BIS 8. NOVEMBER 1974 DURCHGEFUEHRTEN MESSUNGEN]

20 Oct. 1975 22 p refs In GERMAN

(ISL-R-129/75) Avail: NTIS HC A02/MF A01

Two different optical methods for laser anemometry, namely, two-focus and Doppler anemometry, as well as several suitable evaluation methods, are compared with each other by common measurements. A short description is given of the methods, and the equipment configurations used for comparative measurement. Test results are discussed and show good agreement for a low degree of turbulence, i.e. less than 5%. Some disparity is obtained for higher turbulence degrees. ESA

N77-11375# Institut Franco-Allemand de Recherches, St. Louis (France).

APPLICATION OF HYPERVELOCITY BACKWARD REFERENCE HOLOGRAPHY TO THE STUDY OF DYNAMIC DEFORMATIONS [APPLICATION DE L'HOLOGRAPHIE ULTRA-RAPIDE A REFERENCE ARRIERE A L'ETUDE DE DEFORMATIONS DYNAMIQUES]

P. Smigielski, H. Fagot, and F. Albe 10 Dec. 1975 15 p refs In FRENCH

(Contract DRME-75/057)

(ISL-R-135/75) Avail: NTIS HC A02/MF A01

The deformations of a sapphire disk due to the impact of hypervelocity Pb projectile were visualized using color holographic mounting (backward reference holography) combined with the double exposure technique. The hologram was observed by reflection and in white light (sun, pocket lamp). The processing of the gelatin in a triethanol amine solution allows the hologram to restitute the original recorded color. ESA

N77-11376# Institut Franco-Allemand de Recherches, St. Louis (France).

DENSITY MEASUREMENT OF COPPER SHAPED CHARGE JET USING THE FLASH RADIOGRAPHY [MESURE DE LA DENSITE D'UN JET DE CHARGE CREUSE EN CUIVRE PAR RADIOGRAPHIE-ECLAIR]

F. Jamet 9 Jan. 1976 17 p refs In FRENCH

(ISL-R-101/76) Avail: NTIS HC A02/MF A01

The jet density of a shaped charge with copper coating was determined by flash radiography using the equivalent of the thickness and the optical density in the X-ray absorption formula. The principles of the method are presented. The experimental design is described. Processing of optical data shows that the density of the unfragmented jet is about 85% of the coating density which approximates a liquid state of this jet. The density of the jet during fragmentation as well as of the fragments is approximately equal to the coating density. Therefore the perforation by unfragmented jets is 10% less than the one calculated assuming initial density conservation and applying hydrodynamic theory to the perforation. ESA

N77-11377# VDEH-Institut fuer Angewandte Forschung G.m.b.H., Duesseldorf (West Germany).

FURTHER DEVELOPMENT OF A METHOD FOR MEASURING VELOCITY AND LENGTH BY LASER TECHNOLOGY Final Report

Wolfgang Schulz Bonn Bundesmin. fuer Forsch. u. Technol. Jun. 1976 65 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-T-76-17) Avail: NTIS HC A04/MF A01; ZLDI, Munich, DM 13.25

The continued development of methods for contactless measurements of velocity and length by means of laser light is described. Measuring principles used are based on reflected speckled laser light, in combination with an optical grating, and the differential Doppler method. Constructions of the optical systems for obtaining the best results are discussed and the chosen arrangements are described. Measurements with an accuracy of 0.1 % are possible with these methods. The systems were installed for different measurements in rolling mills of the iron and steel industry. Author (ESA)

N77-11378# National Bureau of Standards, Washington, D.C. Analytical Chemistry Div.

ERRORS OBSERVED IN QUANTITATIVE ION MICROPROBE ANALYSIS Final Report

D. E. Newbury, K. F. J. Heinrich, and R. L. Myklebust 1976 16 p refs Repr. from the Proceedings of Am. Soc. for Testing and Materials Symp. on Surface Analysis Techniques for Metallurgical Applications, ASTM Special Technical Pub. 596, 1976 p 101-113 Held at Cleveland, Ohio, 4 Mar. 1975

(PB-252400/7) Avail: NTIS HC A02/MF A01 CSCL 14B

Quantitative reduction of ion microprobe mass analyzer data performed with an empirical technique involving relative elemental sensitivity factors, and with a physical model, the local thermodynamic equilibrium (LTE) model. A series of macroscopically well--characterized low alloy steels was analyzed with empirical relative sensitivity factors derived from one arbitrarily chosen alloy from the series. Relative errors of less than 50 percent were obtained in most cases, but several results were in error by 100 percent or more. The LTE model was used to analyze two multicomponent glasses. Relative errors of 200 percent were observed frequently, with some components consistently in error by an order of magnitude or more. The effect of differing reference data on LTE model calculations was tested. The calculated concentrations showed considerable dependence on the choice of reference data. GRA

N77-11379# National Bureau of Standards, Washington, D.C. Mechanics Div.

AN ANALYSIS OF INERTIAL SEISMOMETER-GALVANOMETER COMBINATIONS Final Report

Daniel P. Johnson and Harry Matheson Jul. 1976 206 p refs Reissue of NBS report 7454

(PB-254475/7; NBSIR-76-1089; NBS-7454) Avail: NTIS HC A10/MF A01 CSCL 14B

The fundamental equations for an inertial seismometer with an electromechanical transducer are developed. If the inductance as well as the resistance of the system are included, the equations of motion are of the third order. These are discussed in some details. Response curves are developed for several seismometer-galvanometer combinations, some of which are suitable for telemetry. Techniques are discussed for calibration, both in the laboratory and in the field. Practical and theoretical limitations are treated for circumstances in which thermal agitation is a major source of instrumental noise. The bibliography includes lists of equivalent notations. GRA

N77-11380# General Electric Co., Wilmington, Mass.

DEVELOPMENT OF FUEL CELL CO DETECTION INSTRUMENTS FOR USE IN A MINE ATMOSPHERE

R. M. Dempsey, A. B. LaConti, M. E. Nolan, R. A. Torkildsen, and G. Schnakenberg 19 Dec. 1975 95 p refs

(Contract DI-BM-HO-357078)

(PB-254823/8; BM-OFR-77-76) Avail: NTIS HC A05/MF A01 CSCL 14B

A fuel cell sensor instrument for monitoring of carbon monoxide in a mine atmosphere was developed. Parametric testing was conducted on two-electrode and three-electrode sensor cells to define performance and life characteristics as a function of temperature, feed flow, and applied sensor voltage. Extended life testing was conducted on best sensor cells under continuous and intermittent operation with feed gases to define possible life limitations for the mine application. Reliable, efficient gas sampling and electronic control circuitry were fabricated for use with the fuel cell sensor and integrated into a device to meet performance and design specifications for a portable, battery-powered handheld direct indicating gas detector for use underground. GRA

N77-11381# National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.

MODIFICATION OF AN NBS REFERENCE SPECTROPHOTOMETER Final Report

Kenneth L. Eckerle Jul. 1976 46 p refs

(PB-255539/9; NBS-TN-913) Avail: NTIS HC A03/MF A01 CSCL 14B

The description of a new reference spectrophotometer capable of making transmittance measurements accurate to 0.0001 transmittance units has already been reported. The purpose of this publication is to describe some modifications that have been made to this instrument and to report some further measurements performed with it. The extension of the range of the instrument down to 200 nm, providing a capability for making measurements over the spectral range 200 to 800 nm, is outlined, and extensive testing of the light averaging effectiveness of several types of devices and spheres is reported. GRA

N77-11382# National Bureau of Standards, Washington, D.C.
IMPROVED MICROWAVE-DISCHARGE SOURCE FOR UV PHOTOEMISSION Final Report
T. V. Vorburger, B. J. Waclawski, and D. R. Sandstrom 19 Aug. 1975 6 p refs Repr. from Rev. Sci. Instrum., v. 47, no. 4, 1976 p 501-504 Sponsored in part by ONR
(PB-255204/0) Avail: NTIS HC A02/MF A01 CSCL 14B

A microwave-discharge UV light source was improved to yield significant photon fluxes at 26.9 and 40.81 eV. In order to optimize the 26.9-eV (NeII) and 40.81-eV (HeII) radiation, the discharge was operated at approximately 2.5 Pa (0.019 Torr) in an external constant magnetic field of approximately 0.070 T (700 G), which, together with the oscillating electric field of the cavity, produces electron cyclotron resonance. When the discharge conditions were optimized for production of 40.81-eV photons, features near the Fermi energy in the photoemission distribution from W(100) for 40.81-eV photons are approximately 6% as intense as the corresponding features in the distribution for 21.22-eV photons. We estimate that under these conditions the flux of 40.81-eV photons is roughly 50% of the flux of 21.22-eV photons. Photoemission energy distributions with h(nu)=16.85, 21.22, 26.9, and 40.81 eV have been measured for saturated exposures of CO on W(100) at a temperature of approximately 80 K. The variation in these data with photon energy is important for making orbital assignments to the energy levels of adsorbed molecular CO. GRA

N77-11383# National Bureau of Standards, Washington, D.C.
REVIEW OF THE CIE PHOTOMETRIC MODEL AND OF THE STATUS OF RADIOMETRIC MEASUREMENTS Final Report
Bruce W. Steiner 1976 12 p Presented at Proc. of Symp. on The Basis for Effectiveness Management of Lighting Energy, Washington, D.C., 29-30 Oct. 1976 p 185-195 Submitted for Publication
(PB-255209/9) Avail: NTIS HC A02/MF A01 CSCL 14B

The CIE photometric model universally used for heterochromatic photometry is studied as an additive model, in contrast to the behavior of the eye in viewing large areas. Although this additivity is not valid visually, the practical advantages of such a system until now have outweighed the disadvantages. The most careful spectral measurements now show a 2 percent spread in the visible, comparable to the best photometric measurements. GRA

N77-11384# Meteorology Research, Inc., Altadena, Calif.
OPTICAL METHOD FOR MEASURING THE MASS CONCENTRATION OF PARTICULATE EMISSIONS Final Report
Gregory R. Markowski, George J. Woffinden, and David S. Ensor Mar. 1976 96 p refs
(Contract EPA-68-02-1749)
(PB-255093/7; MRI-75-FR-1379; EPA-600/2-76-062) Avail: NTIS HC A05/MF A01 CSCL 14B

The feasibility of an in-situ across-the-stack optical technique to measure the mass of particulate emissions from stationary sources was investigated. The technique uses small angle light scattering and transmittance to determine a quantity closely related to particulate mass concentration. The forward scattered light is measured at an angle of 1 deg or less. The technique has been investigated both theoretically using Mie theory, and experimentally using aerosols produced in the laboratory. The experimental results agree with the theoretical predictions and indicate that the method is relatively insensitive to changes in aerosol parameters such as particle size, refractive index, and shape. GRA

N77-11385# Naval Surface Weapons Center, White Oak, Md.
ULTRASONIC INSPECTION OF SEAT-BACK EJECTION ROCKET MOTORS Interim Report
Gerald V. Blessing Dec. 1975 20 p
(AD-A024379; NSWC/WOL/TR-75-132) Avail: NTIS HC A02/MF A01 CSCL 14/2

Ultrasonic methods are described for detecting unbond regions between the steel casing and solid propellant in seat-back ejection rocket motors. Feasibility tests on motors filled with a propellant simulant have demonstrated that at least two techniques are viable: (1) a resonance of the steel casing at a specific ultrasonic frequency, and (2) monitoring the acoustic energy losses produced by the air gaps in regions of steel-propellant unbond. The resonance technique holds more promise since it does not depend on the internal rocket propellant geometry, whereas the second technique does. Recommendations based on results obtained to date are given for developing a nondestructive testing technique suitable for the 100% assembly line inspection of these rocket motors. The envisioned systems, besides being inexpensive, would be independent of operator judgment errors. GRA

N77-11386# Bureau of Mines, Pittsburgh, Pa.
A SPIRAL SEQUENTIAL SAMPLER FOR AIR AND LIQUIDS, PRELIMINARY RESULTS
Robert P. Vinson and Fred N. Kissell Jun. 1976 12 p
(PB-255435/0; BM-RI-8153) Avail: NTIS HC A02/MF A01 CSCL 08I

A sequential sampler, based on the Archimedes screw, was developed by the Bureau of Mines. Its initial purpose was to collect air samples during tracer gas studies in underground mines. However, the basic concept can be applied to other sampling needs, including sampling of liquids. A prototype was built and successfully tested. The simple design makes it inherently durable and low in cost. GRA

N77-11387# North Carolina Water Resources Research Inst., Raleigh.
SENSORS FOR CONTINUOUS MONITORING OF TOXIC IONS, NUTRIENTS, AND DISSOLVED GASES IN WATER
Mark S. Shuman and Wavell W. Fogleman Apr. 1976 137 p refs
(Contract DI-14-31-0001-4157)
(PB-254834/5; UNC-WRRI-76-113; W76-09906; OWRT-B-074-NC(1)) Avail: NTIS HC A07/MF A01 CSCL 14B

Ion-selective electrodes and a new type of dissolved gas sensor based on piezoelectric crystals were assessed for use in continuous monitoring of water quality. Relevant stream and effluent water quality standards were reviewed in order to define the constraints on the use of these sensors. The use of sensors in continuous monitoring programs in the United States and other countries was also examined and reviewed. The state-of-the-art of ion selective electrodes for toxic ions, nutrients and dissolved gases in water was reviewed. A tabular summary of electrode characteristics and an extensive bibliography were compiled. GRA

N77-11388# Harry Diamond Labs., Adelphi, Md.
CALFLO: A BASIC LANGUAGE PROGRAM USED IN THE CALIBRATION OF VOL-O-FLOW METERS
Maurice F. Funke Mar. 1976 22 p ref
(DA Proj. 1T1-62114-AH-73; HDL Proj. 304634)
(AD-A025466; HDL-TM-76-3) Avail: NTIS HC A02/MF A01 CSCL 14/2

This report describes CALFLO, a Wang 2200 BASIC program that, with data obtained from the flow meter calibration equipment located in HDL's calibration branch, presents a printout of the data, coefficients of the calibration equations, an analysis of data error, and plots of both normalized data and calibration curves for flow in either direction through a Vol-O-Flo meter. A derivation of the equations used for this calibration also is presented. Author (GRA)

N77-11222# Institut Franco-Allemand de Recherches, St. Louis (France).
REVIEW ON HIGH SPEED APPLICATIONS OF LASER ANEMOMETRY IN FRANCE AND GERMANY
H. J. Pfeifer *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 18 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11223# Naval Surface Weapons Center, White Oak, Md.
APPLICATIONS OF THE LASER DOPPLER VELOCIMETER TO MEASURE SUBSONIC AND SUPERSONIC FLOWS
William J. Yanta and Benjamin J. Crapo *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 8 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11225# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
APPLICATION OF THE DUAL-SCATTER LASER VELOCIMETER IN TRANSONIC FLOW RESEARCH
V. A. Cline (ARO, Inc., Arnold AF Station, Tenn.) and C. F. Lo (ARO, Inc., Arnold AF Station, Tenn.) *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 12 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11227# Kent Univ., Canterbury (England). Physics Lab.
SUPERSONIC VELOCITY AND TURBULENCE MEASUREMENTS USING A FABRY-PEROT INTERFEROMETER
D. A. Jackson and P. L. Eggins *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 13 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11228# Institut Franco-Allemand de Recherches, St. Louis (France).
RECENT APPLICATIONS OF ISL OF THE LASER VELOCIMETER MEASUREMENTS IN TURBULENT FLOWS [APPLICATIONS RECENTES, A L'ISL, DE LA VELOCIMETRIE LASER AUX MESURES DANS DES ECOULEMENTS TURBULENTS]
X. Bouis *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 12 p refs In FRENCH; ENGLISH summary (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11229# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
ANALYSIS OF THE OUPUT DATA OF A LASER DOPPLER VELOCIMETER
M. L. Riethmuller *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11231# Royal Aircraft Establishment, Farnborough (England).
DEVELOPMENT OF PHOTON CORRELATION ANEMOMETRY FOR APPLICATION TO SUPERSONIC FLOWS
J. B. Abbiss *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11237# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
QUALITATIVE AND QUANTITATIVE FLOW FIELD VISUALIZATION UTILIZING LASER-INDUCED FLUORESCENCE
C. Forbes Dewey, Jr. *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 7 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11239# Princeton Univ., N.J.
RESONANT DOPPLER VELOCIMETER
Richard B. Miles *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 8 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11240# Purdue Univ., Lafayette, Ind. Applied Optics Lab.
FRINGE MODE FLUORESCENCE VELOCIMETRY
Warren H. Stevenson, Reginaldo DosSantos, and Stephen C. Mettler *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 9 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11241# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Linder Hoehe (West Germany).
THE LASER-DUAL-FOCUS FLOW VELOCIMETER
R. School *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 9 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11242# Technisch Physisch Dienst TNO-TH, Delft (Netherlands).
THE USE OF ROTATING RADIAL DIFFRACTION GRATINGS IN LASER DOPPLER VELOCIMETRY
J. Oldengarm *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 6 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11243# Atomic Energy Commission Research Establishment, Riso (Denmark). Electronics Dept.
THE TIME-OF-FLIGHT LASER ANEMOMETER
L. Lading *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 20 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

N77-11248# Brown Univ., Providence, R. I.
A THREE-COMPONENT LASER-DOPPLER-VELOCIMETER
T. Gunnar Johansson (Chalmers Univ. of Tech., Sweden), Lars F. Jernqvist (Chalmers Univ. of Tech., Sweden), Sture K. F. Karlsson, and Nils Froessling (Chalmers Univ. of Tech., Sweden) *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 4 p (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

36 LASERS AND MASERS

Includes parametric amplifiers.

N77-11389*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONSIDERATIONS TO ACHIEVE DIRECTIONALITY FOR GAMMA RAY LASERS
S. Jha (Cincinnati Univ.) and J. Blue 1976 5 p refs Presented at Princeton Univ. Conf. on Partially Ionized Plasmas Including the Third Symp. on Uranium Plasmas, Princeton, N. J., 10-12 Jun. 1976
(Grant NsG-3091)
(NASA-TM-X-73580; E-8933) Avail: NTIS HC A02/MF A01 CSCL 20E

A method of alignment of nuclei for a gamma ray laser and a means of achieving preferential emission of radiation along the crystal axis are discussed. The proposed method of preferential emission of radiation along the aligned needles is to have a symmetric field gradient at the nucleus and a sequence of excited levels of spin and parity 2(+) and C(+). The proposed scheme reduces the density of excited states required for lasing and reduces the linewidth due to inhomogeneous broadening. Mossbauer absorption experiments intended to test these ideas are outlined. Author

N77-11390*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVESTIGATING COMPLEX AERODYNAMIC FLOWS WITH A LASER VELOCIMETER

K. L. Orloff, V. R. Corsiglia, J. C. Biggers (Army Air Mobility Res. and Dev. Lab., Moffett Field), and T. W. Ekstedt (Calif. Univ., Davis) Oct. 1976 30 p refs
(NASA-TM-X-73171; A-6765) Avail: NTIS HC A03/MF A01 CSCL 20E

The application of the laser velocimeter in the study of two highly complex aerodynamic flows is discussed. In the first experiment, the laser velocimeter was used with frequency tracking electronics to survey the multiple vortex wake structure behind a model of a large jet transport. The second application is to the study of the induced instantaneous inflow velocities near the blades of a model helicopter rotor; counter-type processing was used in these measurements. In each experiment, the data output channels of these processors were handled in an on-line fashion, including both velocity computations and the plotting of fully reduced data. Author

N77-11391# Technische Univ., Berlin (West Germany). Inst fuer Luft- und Raumfahrt.
LASER APPLICATIONS IN FLIGHT CONTROL Final Report [STUDIE UEBER DIE LASERANWENDUNG IN DER FLUGFUEHRUNG]
W. Holzapfel, F. Herzmann, and H. Henniger Jan. 1976 349 p refs In GERMAN Sponsored by Fraunhofer Ges. zur Foerder. der Angew. Forsch. e.V.
Avail: NTIS HC A15/MF A01

A survey of the state-of-the-art of laser technology and optoelectronics in flight- and satellite control is presented. Potential applications of these technologies are in measurement and communications, and are of interest to navigation, guidance, and stabilization problems as well as to remote sensing. ESA

N77-11392# Institut Franco-Allemand de Recherches, St. Louis (France).
OPTICAL AND LASER-INTERFEROMETRIC INVESTIGATIONS OF AN ELECTRON-BEAM-CONTROLLED CO2-LASER
M. Hugenschmidt and K. Vollrath . 6 Sep. 1974 23 p refs In GERMAN; ENGLISH summary
(Contract T/R-780/R-7800/41088)
(ISL-35/74) Avail: NTIS HC A02/MF A01

The excitation of the rotational-vibrational states involved with the CO2-laser-transitions is achieved by using short electron pulses of 20 to 40 ns duration with energies up to 750 keV. The spatial and time development of the discharge depending on both the cathode and the acceleration electrode-configuration was studied optically by means of the plasma emission and by holographic interferometry using a ruby-laser. Author (ESA)

N77-11393# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
EFFICIENT HIGH-ENERGY HCl CHEMICAL LASER Semiannual Report, 15 Jan. - 15 Jul. 1975
Leonard Y. Nelson and Stanley R. Byron 15 Nov. 1975 43 p refs
(Contract N00014-75-C-0052; ARPA Order 1807)
(AD-A023787; MSNW-75-131-2; SAR-2) Avail: NTIS HC A03/MF A01 CSCL 20/5

Further improvements in electrical efficiency have been obtained in the HCl chemical laser using a higher current cold cathode electron gun. HCl laser energies of 1.2 J/l-atm at 4 percent electrical efficiency were achieved. There is a strong indication that shorter pulse durations would be desirable, and modifications to the apparatus are currently underway to produce shorter pulse, higher current operation. The HCl laser energy increased four fold when discharge excitation was added to the electron beam excitation. It has not yet been possible to identify the mechanism responsible for the increased laser output associated with discharge excitation; vibrational excitation of H2, and additional atom production are the most likely possibilities. Successful operation of the hydrogen diagnostic equipment (Coherent Anti-Stokes Raman Scattering spectroscopy) (CARS) has been demonstrated and will be applied to explore the role of H2(v) in the reaction kinetics. GRA

N77-11394# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
LASER SCANNING OF MOS IC'S REVEALS INTERNAL LOGIC STATES NONDESTRUCTIVELY Final Report
David E. Sawyer and David W. Berning 25 Aug. 1975 4 p refs Presented at Proc. of IEEE Letters, v 64, no. 3, Mar. 1976 p 393-394 Submitted for publication
(ARPA Order 2397)
(PB-252798/4) Avail: NTIS HC A02/MF A01 CSCL 14B

A laser scanning system was used to observe the internal logic pattern in a MOS LSI device in a nondestructive manner. The laser scanner was also used to selectively change logic states deep within the device. Pictures of the logic patterns revealed by the scanner are discussed. GRA

N77-11395# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
EXPERIMENTAL STUDIES OF A CONTINUOUS-WAVE HF(DF) CONFOCAL UNSTABLE RESONATOR
R. A. Chodzko, F. F. Cross, D. A. Durran, R. R. Giedt, M. A. Kwok, and D. H. Ross 3 May 1976 28 p refs
(Contract F04701-75-C-0076)
(AD-A025268; TR-0076(6605)-1; SAMSO-TR-76-94) Avail: NTIS HC A03/MF A01 CSCL 20/5

A series of experiments were performed on a continuous-wave HF(DF) multiline edge-coupled confocal unstable resonator at The Aerospace Corporation MESA facility. Experimental techniques were developed to measure remotely (from a blockhouse) the output power, the near-field intensity distribution, the spatially resolved spectral content of the near field, and the far-field power distribution. A new technique in which a variable aperture calorimeter absorbing scraper (VACAS) was used for measuring the continuous-wave output power from an unstable resonator with variable-mode geometry and without the use of an output coupling mirror was developed. GRA

N77-11247# United Technologies Research Center, East Hartford, Conn.
SIMULTANEOUS LASER MEASUREMENTS OF INSTANTANEOUS VELOCITY AND CONCENTRATION IN TURBULENT MIXING FLOWS
F. K. Owen *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 7 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N77-11396 Drexel Univ., Philadelphia, Pa.
DISTURBANCE REJECTION AND TWO CLASSES OF MULTIVARIABLE PI CONTROLLERS WITH APPLICATION TO TURBINE-GENERATOR CONTROL Ph.D. Thesis
Kenneth Charles Kalnitsky 1976 175 p
Avail: Univ. Microfilms Order No. 76-22413

Whereas the controllers are dynamic in nature, important aspects of each are revealed by analyzing the equivalent compensator formulations. The analysis includes a study of the poles and zeroes of these multivariable compensators with the intent of determining how they effect disturbance rejection. Pole analysis is a fairly straightforward problem. However, determining the zeroes of a multivariable system is a much more formidable issue. Zero analysis is facilitated by an algorithm which was developed. Closed loop system studies reveal some interesting aspects. Among these are included special cases under which Kalman response is achieved. A selective mechanism of pole-zero cancellation is shown to achieve disturbance rejection in the closed loop. Dissert. Abstr.

N77-11397* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WELD-BONDED TITANIUM STRUCTURES Patent
Robert W. Vaughan (TRW Systems Group, Redondo Beach, Calif.) and John F. Creedon, inventors (to NASA) (TRW Systems Group, Redondo Beach, Calif.) Issued 26 Oct. 1976 5 p Filed 2 Jan. 1975 Sponsored by NASA
(NASA-Case-LAR-11549-1; US-Patent-3,988,561;

US-Patent-Appl-SN-537979; US-Patent-Class-219-92; US-Patent-Class-219-118) Avail: US Patent Office CSCL 13M

Structurally stronger titanium articles are produced by a weld-bonding technique comprising fastening at least two plates of titanium together using spotwelding and curing an adhesive interspersed between the spot-weld nuggets. This weld-bonding may be employed to form lap joints or to stiffen titanium metal plates. Author

N77-11398*# National Aeronautics and Space Administration. Pasadena Office, Calif.

HYDROGEN-FUELED ENGINE Patent Application

Eugene A. Laumann (JPL) and Rollin K. Reynolds, inventors (to NASA) (JPL) Filed 27 Aug. 1976 14 p

(Contract NAS7-100)

(NASA-Case-NPO-13763-1; US-Patent-Appl-SN-718268) Avail: NTIS HC A02/MF A01 CSCL 21A

A hydrogen-oxygen fueled internal combustion engine is described herein, which utilizes an inert gas, such as argon, as a working fluid to increase the efficiency of the engine, eliminate pollution, and facilitate operation of a closed cycle energy system. In a system where sunlight or other intermittent energy source is available to separate hydrogen and oxygen from water, the oxygen and inert gas are taken into a diesel engine into which hydrogen is injected and ignited. The exhaust is cooled so that it contains only water and the inert gas. The inert gas in the exhaust is returned to the engine for use with fresh oxygen, while the water in the exhaust is returned to the intermittent energy source for reconversion to hydrogen and oxygen. NASA

N77-11399*# Kanner (Leo) Associates, Redwood City, Calif.

BOSCH TECHNICAL INSTRUCTION. GASOLINE INJECTION D AND L-JETRONIC

U. Adler Washington NASA Jul. 1976 54 p refs Transl. into ENGLISH from the German report

(Contract NASw-2970)

(NASA-TT-F-17111) Avail: NTIS HC A04/MF A01 CSCL 21A

Two variations of a gasoline injection system are described. In one case, fuel injection is regulated by the pressure in the intake manifold. In the other, the fuel injection rate is determined by the volume of air passing through the intake manifold.Author

N77-11400*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ISOTHERMAL ELASTOHYDRODYNAMIC LUBRICATION OF POINT CONTACTS. III: FULLY FLOODED RESULTS

Bernard J. Hamrock and Duncun Dowson (Leeds Univ., Engl.) Washington Oct. 1976 40 p refs Presented at the Joint Lubrication Conf., Boston, 5-7 Oct. 1976; Cosponsored by the Am. Soc. of Mechanical Engineers and the Am. Soc. of Lubrication Engineers

(NASA-TN-D-8317; E-8712) Avail: NTIS HC A03/MF A01 CSCL 11H

The influence of the ellipticity parameter and the dimensionless speed U, load W, and material G parameters on minimum film thickness was investigated. The ellipticity parameter k was varied from 1 (a ball-on-plate configuration) to 8 (a configuration approaching a line contact). The dimensionless speed parameter was varied over a range of nearly two orders of magnitude. And the dimensionless load parameter was varied over a range of one order of magnitude. Conditions corresponding to the use of solid materials of bronze, steel, and silicon nitride and lubricants of paraffinic and naphthenic mineral oils were considered in obtaining the exponent on the dimensionless material parameter. Author

N77-11401*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NONAXISYMMETRIC INCOMPRESSIBLE HYDROSTATIC PRESSURE EFFECTS IN RADIAL FACE SEALS

Izhak Etsion Washington Nov. 1976 23 p refs

(NASA-TN-D-8343; E-8817) Avail: NTIS HC A02/MF A01 CSCL 11A

A flat seal having an angular misalinement is analyzed, taking into account the radial variations in seal clearance. An analytical solution for axial force, tilting moment, and leakage is presented that covers the whole range from zero to full angular misalinement. Nonaxisymmetric hydrostatic pressures due to the radial variations in the film thickness have a considerable effect on seal stability. When the high pressure is on the outer periphery of the seal, both the axial force and the tilting moment are nonrestoring. The case of high-pressure seals where cavitation is eliminated is discussed, and the possibility of dynamic instability is pointed out. Author

N77-11402*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OPTIMUM STEP DESIGN FOR CENTERING OF PISTONS MOVING IN AN INCOMPRESSIBLE FLUID

Izhak Etsion and Bernard J. Hamrock Washington Nov. 1976 22 p refs

(NASA-TN-D-8345; E-8905) Avail: NTIS HC A02/MF A01 CSCL 13I

Hydrodynamic effects are analyzed for a stepped piston moving within a tight clearance tube filled with an incompressible fluid. Hydrostatic effects are analyzed and a complete solution is obtained and an optimum step design for centering of the piston is suggested. The axial speed resulting from an axial driving force is calculated, and some experimental results for pistons falling in a water-filled tube are presented. Author

N77-11403*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPHERICAL BEARING Patent Application

William N. Myers and Leopold A. Hein, inventors (to NASA) Filed 29 Oct. 1976 16 p

(NASA-Case-MFS-23447-1; US-Patent-Appl-SN-736909) Avail: NTIS HC A02/MF A01 CSCL 13I

Components of the invention include an inner ball having an opening for receiving a shaft and a spherical outer surface, and a circular outer race including a plurality of circumferentially spaced sections extending around the inner ball for snugly receiving the inner ball. A groove extends circumferentially around the race producing a thin wall portion there below which permits the opposed side portions to flex relative to the ball for maximizing the physical contact between the inner surface of the race and the spherical outer surface of the ball. NASA

N77-11404*# Army Aviation Systems Command, St. Louis, Mo.

BEARING RESTORATION BY GRINDING

Heinz Hanau, R. J. Parker, E. V. Zaretsky, S. M. Chen, and Hubert L. Bull 21 May 1976 94 p refs Presented at joint Army-NASA Seminar, St. Louis, 20-21 May 1976 Sponsored by NASA

(NASA-CR-149188; AD-A025420; USAAVSCOM-TR-76-27) Avail: NTIS HC A05/MF A01 CSCL 01/3

A joint program was undertaken by the NASA Lewis Research Center and the Army Aviation Systems Command to restore by grinding those rolling-element bearings which are currently being discarded at aircraft engine and transmission overhaul. Three bearing types were selected from the UH-1 helicopter engine (T-53) and transmission for the pilot program. No bearing failures occurred related to the restoration by grinding process. The risk and cost of a bearing restoration by grinding programs was analyzed. A microeconomic impact analysis was performed. GRA

N77-11405# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.

RESEARCH ON ADHESIVE BONDING AND SURFACE CHARACTERISTICS OF METALS AT FOKKER-VFW

R. J. Schliekelmann 16 Sep. 1974 18 p refs

(FOK-R-1816) Avail: NTIS HC A02/MF A01

Background information is given about the research work that has been carried out on various aspects of the strength and durability of adhesive bonded joints for aerospace applications. That work includes studies on the relation between surface characteristics of metals and the durability of adhesion and corrosion resistance of bonded joints, the research and development on innovative nondestructive adhesion and cohesion testing methods, and adhesion characteristics of esteroil resistant paints. The capabilities in this field of the Fokker-VFW Technological Center at Schiphol, the Netherlands, are given. Author (ESA)

N77-11406# Institut Franco-Allemand de Recherches, St. Louis (France).

BEHAVIOR OF STEEL FRAGMENTS ON THIN DURALUMIN TARGETS. OBLIQUE INCIDENCE. MULTIPLE TARGETS [EFFICECITE DES ACLATS D'ACIER SUR DES CIBLES MINCES DE DURALUMIN. INCIDENCE OBLIQUE. CIBLES MULTIPLES]

G. Herbette, F. Jamet, and J. P. Hancy 27 Mar. 1975 48 p refs In FRENCH

(Contract CEG-404/187/22)

(ISL-R-112/75) Avail: NTIS HC A03/MF A01

A law giving the residual velocity of steel hypervelocity projectiles after penetration of a thin Duralumin target at normal incidence was determined for the 1500 to 2500 m/s velocity range. The effect of angle of incidence was analyzed for the 500 to 4000 m/s range. The limit of opacity (or limit perforation) of multiple targets was determined at normal incidence. The effect of toughness and density of projectiles are briefly analyzed. Some results of the overpressure produced behind the targets during the target perforation are given. ESA

N77-11407# Marconi Space and Defence Systems Ltd., Camberley (England).

LUBRICATION OF BEARINGS IN VACUUM. EXAMINATION OF LIFE-TESTED BEARINGS FROM MSDS LTD Progress Report, Apr. 1975 - Mar. 1976

P. J. ODonnell, comp., A. A. McFarlane, and M. J. Todd Apr. 1976 41 p refs Prepared jointly with Natl. Centre of Tribology, Risley, Engl.

(Contracts ESTEC-1852/73-AA; ESTEC-2474/75-MD)

(T(F)S/128; ESTL/TM/3; ESA-CR(P)-830) Avail: NTIS HC A03/MF A01

Bearing tests in vacuum reported earlier have continued with little change in performance through the period. Testing was terminated on a certain number of the rigs during the period and examination of the condition of these bearings is reported. The two 100 rpm lead lubricated bearings rigs are still running and have now accumulated 45,000 and 47,600 hrs operation while the remaining 100 rpm grease rig has now reached 43,800 hrs. The two remaining 1/90 rpm lead lubricated bearing rigs have run for 46,000 and 39,500 hrs, respectively. These tests have now been terminated. Results from these tests have proven the reliability of the lead lubrication technique when applied to slowly rotating bearings. The bearings have shown remarkable consistency in their torque behavior over a period equivalent to more than 70 years for a geostationary satellite solar array drive. Author (ESA)

N77-11408# Indianapolis Center for Advanced Research, Ind.

AN ASSESSMENT OF FLOW QUALITY REQUIREMENTS FOR THE COMPRESSOR RESEARCH FACILITY Interim Report, 1 Oct. - 31 Dec. 1974

G. D. Huffman, F. R. Ostdiek, and R. B. Rivir Jan. 1976 53 p refs

(Contract F33615-75-C-2008)

(AD-A023888; AFAPL-TR-75-75) Avail: NTIS HC A04/MF A01 CSCL 21/5

A review of the Compressor Research Facility flow quality goals has been carried out. Flow quality standards have been defined. GRA

N77-11409# Naval Ship Research and Development Center, Annapolis, Md. Propulsion and Auxiliary Systems Dept.

PERFORMANCE ANALYSIS OF SPLIT-TURBINE CONCEPTS BASED ON LM-2500 GAS TURBINE COMPONENTS

Rolf K. Muench Apr. 1976 68 p refs

(SF4343270208)

(AD-A024058; PAS-75-50) Avail: NTIS HC A04/MF A01 CSCL 21/5

The performance of various split-turbine configurations based on the General Electric Company LM-2500 gas turbines is investigated with the aid of a component-matching computer program. The program was derived and uses component data from a gas turbine program for the LM-2500 which was produced by the General Electric Company. Split-turbine configurations with maximum power potential of 40,000, 50,000, and 60,000 horsepower (nominal) per shaft for two-shaft configurations and part-power configurations of 20,000 horsepower (nominal) per shaft were investigated. The investigation showed that the components were well matched and resulted in fuel consumption comparable with the basic LM-2500 gas turbine at the high power levels. At the part-power level below 20,000 horsepower the component matching is more difficult, and the split-turbine fuel consumption is slightly higher than that of an equivalent LM-2500 gas turbine. Author (GRA)

N77-11410# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

A STUDY OF THE FACTORS AFFECTING DEPOSITION CHARACTERISTICS OF SYNTHETIC LUBRICANTS FOR GAS TURBINE ENGINES Final Report

A. J. Dorazio, P. A. Karpovich and C. J. Nowack Apr. 1976 65 p refs

(AD-A024472; NAPTC-PE-71) Avail: NTIS HC A04/MF A01 CSCL 11/8

The potential of the neopentyl polyol esters to survive higher surface temperatures without forming excessive harmful coke deposits was investigated. This study consisted of an engineering evaluation of the lubricant deposition-degradation characteristics which could have a significant bearing on the maintainability and reliability of future high thrust to weight ratio engines to be incorporated into the Navy inventory. Relationships were then established between these characteristics and chemical composition of the basestock materials, and to a lesser degree, the oxidation inhibiting packages. The intention of this investigation was to provide cause and effect relationships for the phenomena which were either the strengths or weaknesses of the current formulation philosophies. Such an understanding could open the way to meet the more demanding future requirements. It is equally desirable that engine designers utilize the information presented as a guideline for avoiding those environments which are most conducive to the generation of lubricant degradation products that can jeopardize engine operation. GRA

N77-11411# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

THE ROTATING STATOR CONCEPT. EXPERIMENTAL PERFORMANCE CHARACTERISTICS COMPARED WITH THE CONVENTIONAL COMPRESSOR

M. S. Chappell, D. A. J. Millar, and A. A. Swiderski Jul. 1975 66 p refs

(AD-A024465; DME-ME-242; NRC-1915032) Avail: NTIS HC A04/MF A01 CSCL 21/5

The Small Compressor Research Program is a co-operative project between the National Research Council of Canada (NRC) and Rolls Royce (Canada) Limited (RR). Its objectives are to investigate, both analytically and experimentally, the 'Fanstat' concept of compressor spooling. This concept involves the co-rotation of both rotor and stator rows of a compressor in the core engine, with the fan being mounted on, and driven by, the rotating stator case. The primary function of the fan and stat is to provide an 'aerodynamic gearbox' that will permit the fan and the fan turbine to run close to their individual optimum speeds, so overcoming the mismatch in blade speeds inherent in direct-coupled fan-turbine spools of high-bypass ratio turbofan engines. Previous reports have described preliminary experimental calibrations of the conventional three-stage axial compressor from which the Fanstat compressor was derived, and a hybrid-computer model of the rotating stator compressor test rig. The current report describes a more-detailed calibration of this conventional compressor and presents the performance characteristics of the co-rotating compressor configuration. The test results confirmed aerodynamic feasibility of the Fanstat arrangement of compressor spooling, and major performance parameters were not significantly different from the compressor in the useful operating region. Flow range and surge behavior of the co-rotating compressor were examined and, although somewhat unusual at various speeds, did not indicate any serious limitations on the applicability of the concept. GRA

N77-11412# North Carolina State Univ., Raleigh. Engineering Design Center.

TRANSIENTS IN TURBOCOMPRESSORS Final Report, Jan. 1975 - Feb. 1976

J. N. Perkins, L. W. Hardin, F. O. Carta (United Technol. Res. Center, East Hartford, Conn.), and W. C. Griffith Feb. 1976

49 p refs
(Grant AF-AFOSR-2802-75; AF Proj. 9781)
(AD-A024275; EDC-76-1; AFOSR-76-0501TR) Avail: NTIS HC A03/MF A01 CSCL 21/5

This report describes the work done between the Spring of 1975 and February 1976 on a cooperative program between North Carolina State University and the United Technologies Research Center. The effect of unsteady flow on compressor performance is being investigated experimentally in the UTRC Large Scale Rotating Rig and theoretically at NCSU with a refined computer-based flow model. The goal of the program is to provide improved predictive techniques for use in turbocompressor design based upon an improved understanding of the basic coupling between distorted inlet flow, the onset and disappearance of rotating stall, and compressor stage performance. The diameter is 5 ft. with the maximum rotational speed of 600 rpm. The blade chord of 6 in. coupled with an inlet velocity of 100 ft/sec gives a blade RE approx. 0.000005. Upstream screens provide a 20% sinusoidal variation in axial velocity once per revolution. Rotating instrumentation will measure steady and unsteady surface pressures on the rotor blade, the boundary layer behavior on the blade, and will allow a complete investigation of the 3-D properties of the near wake of the rotor. Stationary frame measurements will include mean and transient inlet and downstream conditions. A 45 channel slipring assembly, with on-board excitation and amplification electronics developed under this program will give high quality signals on 18 transient data channels. A refined theoretical flow model has been developed at NCSU for use in data interpretation, with runs planned for early spring. The program is continuing under a follow-on contract with the AFOSR. Author (GRA)

N77-11413# Naval Ship Research and Development Center, Bethesda, Md.
AN EXPERIMENTAL INVESTIGATION OF BABBITT METAL BONDING
Michael G. Vassilaros May 1976 19 p
(ZF61512001)
(AD-A024306; DTNSRDC-76-0037) Avail: NTIS HC A02/MF A01 CSCL 13/8

Several methods of casting babbitt metal to steel were evaluated for bond strength by use of tensile-type specimens. The methods investigated were the use of a tin bath, torch/tin stick, and electroplated nickel to insure proper babbitt-to-steel bond, as well as no tinning. Of the methods performed, only the tin-bath method consistently produced a bond stronger than the babbitt metal itself. The bond strengths developed in the other methods tested were erratic and always less than that obtained with the tin-bath method. The torch/tin stick method gave an adequate compromise between bond strength and convenient application. It was found that the oxide formed on the tinned surface which precludes good bonding could be effectively removed by the use of flux during babbitt casting.
Author (GRA)

N77-11414# Naval Ship Research and Development Center, Bethesda, Md. Computation and Mathematics Dept.
COMPUTER ANALYSIS OF THE PERFORMANCE OF A SWING-PAD BEARING WITH A COMPLIANT PAD SURFACE
Paul Morawski and Charles W. Dawson Jan. 1976 21 p
(AD-A024418; CMD-03-76) Avail: NTIS HC A02/MF A01 CSCL 13/9

The Swing-Pad bearing is a new lubricated sliding-surface bearing. The swinging action of the pads produces a wedge film which in turn develops fluid-dynamic forces which keep the moving surfaces separated. Theoretical results for Swing-Pad bearing properties were previously developed for a flat pad surface. This report describes results obtained from a computer program written to analyze a Swing-Pad bearing whose surface is elastic and allowed to deform. The deformation of the bearing surface was found to have a minor effect on bearing performance for small loads. However, as the load increases, the effect of the deformation becomes dominant and limits the load that the bearing can support. Author (GRA)

N77-11415# Rock Island Arsenal, Ill. General Thomas J. Rodman Lab.
SHOT PEENING PROCEDURES FOR HELICAL COMPRESSION SPRINGS Final Report, Jun. 1973 - Jan. 1975
Henry P. Swieskowski Sep. 1975 34 p
(AD-A023758; RIA-R-TR-76-013) Avail: NTIS HC A03/MF A01 CSCL 13/9

Various shot-peening procedures for the manufacture of cold-wound helical compression springs were investigated to establish optimum shot-peening methods to increase the life endurance properties of springs. Production springs that are typical of small arms applications were fabricated from music wire and stainless steel materials. The springs were given different shot-peening treatments with the exception of control groups that were not shot-peened. Effect of the various shot-peening procedures on spring life was evaluated by laboratory endurance tests. Recommended shot-peening procedures based on test results are given for the spring materials and stress conditions investigated in this project. Author (GRA)

N77-11416# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
DEVELOPMENT OF MATHEMATICAL MODEL FOR PNEUMATIC TIRE-SOIL INTERACTION IN LAYERED SOILS Final Report
L. L. Karafiath Nov. 1975 129 p refs
(Contract DAAE07-75-C-0066; DA Proj. 1T1-61102-B-52A)
(AD-A024162; RE-516; TACOM-TR-12109; LL-152) Avail: NTIS HC A07/MF A01 CSCL 13/6

Mathematical models of tire-soil interaction have been developed for nonhomogeneous soil conditions where the soil strength varies either continuously or discretely with depth. New methods of solving the differential equations of plasticity for soils have been developed for the bearing capacity problem in two-layer soils. Composite slip line fields obtained by these methods and the associated bearing stresses are shown for two cases: upper layer stronger than the lower layer and upper layer weaker than the lower layer. An approximate procedure, based on these composite slip line fields, is given for the estimation of bearing stresses in two-layer soils. This approximate procedure is applied in a tire-soil model expanded for the consideration of two-layer soils. The simulation of tire performance by this expanded model is compared with results of small-scale mobility tests performed at the U.S. Army Engineer's Waterways Experiment Station (WES) in layered soils. Field methods of determining soil properties in layered soils are examined, and a modification of ring shear tests is recommended for the determination of the strength of individual layers in layered soils. Author (GRA)

N77-11417# Army Materials and Mechanics Research Center, Watertown, Mass.
CERAMIC MATERIALS AND COMPONENTS FOR SMALL AUTOMOTIVE GAS TURBINE ENGINE
30 Apr. 1975 46 p
(AD-A025472) Avail: NTIS HC A03/MF A01 CSCL 21/5

The vehicular ceramic gas turbine offers the potential of at least a 30% improvement in fuel economy compared to today's piston engine and could be made available on a production basis by the mid-1980's. The beneficial impact in future energy demands, multiple fuel potential and lessened dependence on foreign materials is sufficient motivation to initiate the recommended programs. Author (GRA)

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N77-11418 New Jersey Inst. of Technology, Newark.
DISTRIBUTED PARAMETER SENSITIVITY THEORY TO SOLVE CERTAIN RELIABILITY PROBLEMS Ph.D. Thesis
Moses Nee Buernor Ayiku 1976 166 p
Avail: Univ. Microfilms Order No. 76-23730

The study of parameter sensitivity is extended to higher order distributed parameter control systems. The dynamic system

of interest is represented by a nonlinear higher order vector partial differential equation and its associated matrix sensitivity equation. The problem posed is that of minimizing a cost functional consisting of both the performance and trajectory sensitivity indices subject to the state and sensitivity equations of the system. By means of variational techniques, the necessary conditions for optimality are obtained. The sufficient conditions are also derived using the theory of convexity. The theory developed is applied to two classes of reliability models of wide applicability. These are represented by the standby redundant system and the semi-infinite parabolic PDE. The resulting co-state equations, together with the system's equations, are discretized in both space and time. Dissert. Abstr.

N77-11419# Mound Lab., Miamisburg, Ohio.
ULTRASONIC EXAMINATION OF THIN IRIDIUM HEMISPHERES FOR THE MULTIHUNDRED WATT HEAT SOURCE
W. A. Dudley 30 Dec. 1975 14 p refs
(Contract E(33-1)-GEN-53)
(MLM-2291) Avail: NTIS HC A02/MF A01

An ultrasonic method was developed for nondestructive inspection of the structural integrity of the 20-mil 0.0508-cm) thick iridium hemispheres that are used in the fabrication of Multihundred Watt (MHW) radioisotopic heat sources. A hemisphere was considered unacceptable if a back-surface ultrasonic response change was equivalent to that obtained from a 0.010-in. (0.0254cm) diameter flat-bottomed hole in the standard. Flaws were detected in hemispheres made by the initial fabrication process. Typical flaws found ultrasonically in these units and revealed by metallography are shown. Hemispheres formed after a change to a different fabrication process were free of flaws. Author (ERA)

N77-11420# Applied Psychological Services, Wayne, Pa. Science Center.
A MODEL FOR PREDICTING INTEGRATED MAN-MACHINE SYSTEM RELIABILITY. 2: MODEL VALIDATION
Arthur I. Siegel, J. Jay Wolf, and Allan R. Williams Mar. 1976 133 p refs
(Contract N00024-72-C-1277)
(AD-A023886) Avail: NTIS HC A07/MF A01 CSCL 05/8

Validation and additional sensitivity test of a computer simulation model for predicting integrated system reliability are described. Integrated or total system reliability is considered to be dependent on both operator/maintainer reliability and on equipment reliability. The validation and sensitivity tests are based on the AN/SQS-26 sonar system. Both the sensitivity test data and the validation data are considered to support the model. Operational use of the model for its intended purpose is recommended. Author (GRA)

N77-11421# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
PROCEDURE FOR MAINTENANCE AND REWORK PROCESS QUALITY CONTROL BASED ON RANDOM SAMPLING
Richard S. Leavenworth, Richard L. Scheaffer, and Charles J. Lyon Feb. 1976 80 p refs
(Contracts N00014-68-A-0173-0021; N00014-75-C-0783)
(AD-A024257; RR-76-4) Avail: NTIS HC A05/MF A01 CSCL 13/8

This work presents an inspection system for application in component shops wherein there is a similarity in the tasks performed but little similarity in the size and complexity of the items maintained. Sample sizes and switching rules are provided for normal, reduced, and tightened inspection as well as 100% inspection. The system is based on the use of acceptance control charging techniques coded against an Acceptable Quality Level and an Average Outgoing Quality Limit. Curves and tables of Average Fraction Inspected are provided as well as Operating characteristic curves. GRA

N77-11422# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
TECHNICAL REPORT ACCOMPANYING PROCEDURE FOR MAINTENANCE AND REWORK PROCESS QUALITY CONTROL BASED ON RANDOM SAMPLING Technical Research Report
Richard S. Leavenworth, Richard L. Scheaffer, and Charles J. Lyon Mar. 1976 42 p refs
(Contracts N00014-68-A-0173-0021; N00014-75-C-0783)
(AD-A024256; RR-76-5) Avail: NTIS HC A03/MF A01 CSCL 13/8

This report accompanies ISE Research Report 'Procedure for Maintenance and Rework Process Quality Control Based on Random Sampling'. It contains the formulation of the mathematical model as a semi-Markov process, the assumptions made and techniques used to minimize the Average Fraction Inspected at the designated Acceptable Quality Level. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N77-11423 Colorado Univ., Boulder.
THE FINITE INTEGRAL METHOD APPLIED TO SOME PROBLEMS OF STRUCTURAL MECHANICS Ph.D. Thesis
Mustafa Mohammed Tawil 1976 250 p
Avail: Univ. Microfilms Order No. 76-23689

The governing equations for such problems were either linear ordinary differential equations or partial differential equations with variables separable. The latter were transformed into a set of linear ordinary differential equations before the finite integral method was applied. The finite integral method is a numerical technique which provides an alternative to the finite difference method for solving certain differential equations. It was first proposed by Trahair and Brown in Australia, and Trahair, with others, has applied it to solve many beam buckling problems. The highest derivative in a given linear ordinary differential equation is considered as an unknown function, and the lower derivatives are expressed in terms of that function by simple integration. These are substituted into the governing differential equations to transform them into integral equations which are solved numerically at selected nodal points. Dissert. Abstr.

N77-11424 Clemson Univ., S.C.
TRESCA YIELD CONDITION IN ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS Ph.D. Thesis
Frank Emil Weisgerber 1976 98 p
Avail: Univ. Microfilms Order No. 76-23044

Elastic-plastic problems are frequently solved by numerical methods of analysis, such as the finite element method, which require the assumption of a yield condition. In the past, the Von Mises yield condition was assumed almost exclusively. However, alternate yield conditions may be preferred in some circumstances. Incremental elastic-plastic, stress-strain relations for isotropically strain hardening materials which obey the Tresca yield condition are developed and presented. Both plane stress and plane strain conditions are considered. These relations are not fundamentally restricted to any particular solution scheme. Two different solution schemes, an interpolative scheme and an iterative scheme, are discussed. In order to illustrate the use of these relations and solution schemes, several solutions for notched tensile specimens subjected to monotonically increasing loads are presented. Dissert. Abstr.

N77-11425 Lehigh Univ., Bethlehem, Pa.
EFFECT OF POLYMER STATE ON THE MECHANICAL AND TRANSPORT BEHAVIOR OF POLYMER IMPREGNATED MORTARS Ph.D. Thesis
Yu-Nan Liu 1976 222 p
Avail: Univ. Microfilms Order No. 76-21820

The impregnation of concrete with poly(methyl methecrylate) (PMMA) was found to possess much improved mechanical properties (strength and modulus) and corrosion resistance, as well as fracture energy. However, preliminary studies found that the strength and modulus of polymer-impregnated concretes and mortars depend very much on the nature of the polymer. To pursue further the question of the role of the viscoelastic state

of the polymer, the effects of temperature and polymer composition on the mechanical properties and fracture toughness of polymer-impregnated Portland cement mortars were studied systematically. Resistance to the penetration of aqueous salt solution was also studied as a function of polymer state. Dissert. Abstr.

N77-11426 Virginia Univ., Charlottesville.
LOCAL INSTABILITY OF SANDWICH PLATES Ph.D. Thesis
Bahong Kuo 1976 138 p
Avail: Univ. Microfilms Order No. 76-22841

A method is presented for solving the wrinkling problem of a sandwich plate with an edge stiffener subjected to concentrated loading. The problem is modeled as a plate on an elastic foundation. The primary objective is to predict the critical load which causes the plate facing sheet to wrinkle. The method of analysis is based on a finite element approach. An experiment is performed to determine the stress distribution along the edge of the stiffener due to the concentrated loading, and also to determine the in-plane stress distribution in facing material. The experimental results of strains and stresses are presented. A stiffness matrix of a plate on an elastic foundation element for solving the instability problems is derived which leads to an eigenvalue problem. Dissert. Abstr.

N77-11427 Oregon State Univ., Corvallis.
VIBRATIONS OF SUSPENDED CABLES Ph.D. Thesis
John Gregg Gale 1976 132 p
Avail: Univ. Microfilms Order No. 76-23515

The equations of motion of an elastic cable suspended in a viscous medium from two arbitrary points are derived. These are then linearized for the undamped, inextensible case, and it is found that the equations describing the in-plane motion of the cable are then independent of the equation describing the out-of-plane motion of the cable. Using the equations developed for the normal mode motion, a technique is presented for determination of the displacements and tensions throughout a cable when one end is subjected to a prescribed tangential displacement of known frequency. Maximum cable tensions are presented as a function of the forcing frequency for a variety of cable geometries. Dissert. Abstr.

N77-11428 Polytechnic Inst. of New York.
STEADY STATE RESPONSE OF SHELL STRUCTURES Ph.D. Thesis
Rabindra Kumar Dubey 1976 84 p
Avail: Univ. Microfilms Order No. 76-23402

The steady state response of shell structures under axial and lateral excitation was investigated. The two point boundary value problem is solved by reducing the equations of motion to a system of first order differential equations, and applying the method of stepwise integration. The axial vibration transmission characteristics for cylindrical shells as a function of circumferential mode number was determined. The results for short and long cylindrical shells with various boundary conditions were presented as elements of a transfer matrix. The response of laterally excited cylindrical shells and containment vessels was obtained, and the stresses, moments, and displacements along the shell generator were determined as a function of frequency. Dissert. Abstr.

N77-11429 Colorado Univ., Boulder.
EXPERIMENTAL AND NUMERICAL STUDIES OF RATE-DEPENDENT MATERIALS Ph.D. Thesis
Bharat Bhusan 1976 144 p
Avail: Univ. Microfilms Order No. 76-23591

A modified version of the conventional Kolsky apparatus is described and used. This method permits testing a specimen in nearly uniaxial strain conditions. In the modified Kolsky apparatus, the radial motion of the specimen is suppressed by a massive collar. Clearance between the inner liner and the specimen is maintained at a minimum to insure that the radial Poisson expansion of the specimen is resisted from the beginning of loading. A bell-shaped input stress pulse is used. Semiconductor strain gages are mounted on the input bar and the output bar in order to obtain the incident reflected and trasmitted stress histories. Data reduction utilizes the conventional Kolsky formulas for the determination of axial stress and strain histories in the specimen, and a supplementary equation was developed to calculate the radial stress history for ductile metallic specimens. Dissert. Abstr.

N77-11430 Tennessee Technological Univ., Cookeville.
NONLINEAR ANALYSES OF THE STRESS FIELD NEAR A CRACK OR HOLE IN A PLATE Ph.D. Thesis
Kenneth William Suits 1975 128 p
Avail: Univ. Microfilms Order No. 76-22003

An analytical theory for a nonlinear crack problem was presented along with a nonlinear finite element approach to the problem of a plate with a centrally located hole. The plate was loaded in tension, and the two-dimensional solution was based on an incremental theory of plane stress. Elaborate programs were written making use of the modern computer to solve the lengthy algebraic statements associated with the plate containing cracks and cutouts subjected to a loaded condition. Appropriate verification curves were plotted indicating the deviation between existing linear theories and the presented theories utilizing nonlinear considerations. These curves indicated the inaccuracy of linear solutions in the immediate cracktip vicinity and also near a hole boundary. Complete stress fields were obtained, and corresponding stress curves were plotted. Dissert. Abstr.

N77-11431 Vanderbilt Univ., Nashville, Tenn.
ON THE NATURE OF THE CLOSURE PHENOMENA AND ITS EFFECT ON FATIGUE CRACK GROWTH RATE Ph.D. Thesis
Gunter Marci 1976 114 p
Avail: Univ. Microfilms Order No. 76-22355

Optical interference of monochromatic light between the specimen surface and an optical flat is used to obtain the transverse displacement field associated with a fatigue crack in a sheet specimen. By making the assumption that the transverse displacement in the elastic region of the specimen obeys a different functional relation to the stresses than the transverse displacement in the plastic region the elastic-plastic boundary can be determined. It was found that the plastic zone in front of the fatigue crack is semi-elliptical in shape. Polishing the specimen surface after a fatigue crack had been introduced eliminated the plastic transverse displacement associated with the plastic stretch. In this manner the geometric nature of closure can be studied during reloading of the specimen. It is shown that closure is a surface phenomenon and occurs in the plane stress region of the specimen. Closure on the surface accounts for the thickness dependence of the fatigue crack growth rate and the increase in growth rate associated with the transition from flat to slant fracture. Dissert. Abstr.

N77-11432 Vanderbilt Univ., Nashville, Tenn.
CHARACTERIZATION OF FATIGUE CRACKS WITH ULTRASONICS Ph.D. Thesis
Dennis Martin Corbly, Jr. 1976 157 p
Avail: Univ. Microfilms Order No. 76-22334

The model of the theoretical crack was a thin layer with acoustic properties different from the surrounding material. This model correctly predicted the time and frequency ultrasonic pulse echo responses in an aluminum-adhesive layer aluminum system. The model showed that frequency spectrum analysis was inadequate for characterizing pulses from thin gaps and from fatigue cracks due to the limited bandwidth of available ultrasonic transducers. It was shown that changes in ultrasonic reflected amplitude from fatigue cracks as a function of stress were due primarily to changes in the amount of contact area. Three methods of ultrasonic signal amplitude analysis indicated that larger areas of crack surface were in contact at the specimen edge than in the interior. This agrees with crack closure distributions predicted by interferometry and electric potential studies. Dissert. Abstr.

N77-11433 New Mexico Univ., Albuquerque.
TRANSIENT ANALYSIS OF A THREE-DIMENSIONAL ELASTIC PLATE BY THE RAY GROUPING TECHNIQUE Ph.D. Thesis
John Han-Hsiung Wu 1975 114 p
Avail: Univ. Microfilms Order No. 76-22169

The propagation of transient waves in an elastic thick plate excited by an arbitrary loading is investigated. The technique consists of finding the n-th reflected and transmitted wave from

only the information on the (n-1)-th reflected and transmitted wave. The interpretation of the infinite series, which represents multi-reflected shear and dilatational waves, is verified by a Ray Grouping Technique. Using the mode conversion matrix, the physical meaning of each term of the infinite series is discussed, and a proof of the convergence of the infinite series is given. A nonaxially symmetric sample loading is chosen for application of the technique, and only a finite number of terms is required to determine the velocities for any particular finite time of interest. The final expressions are used to deduce the Green's function for the velocity, and numerical results are presented for a step function input. Dissert. Abstr.

N77-11434 Syracuse Univ., N.Y.
STIFFNESS AND STRESS ANALYSIS OF DISCRETELY ATTACHED CORRUGATED SHEAR WEBS WITH QUASI-SINUSOIDAL CORRUGATIONS Ph.D. Thesis
Lung-Hsiang Wu 1975 97 p
Avail: Univ. Microfilms Order No. 76-18574

A theoretical analysis and numerical data are presented for the shear stiffness of curvilinearly corrugated shear webs with discrete attachments to framing members at the ends of the corrugations, and for the maximum transverse extreme-fiber flexural stresses and strains due to the cross-sectional deformations which arise during the shearing of such webs. Four kinds of discrete attachments are considered at the ends of the corrugations: (a) point attachments in the troughs, (b) point attachments in the troughs and at the crests, (c) point attachments at mid-height, and (d) point attachments in the troughs, at the crests and at mid-height. Dissert. Abstr.

N77-11435 Denver Univ., Colo.
NONLINEAR PERIODIC RESPONSE OF A SLENDER BEAM-COLUMN Ph.D. Thesis
Barry Pierce Shafer 1976 183 p
Avail: Univ. Microfilms Order No. 76-17873

The nonlinear dynamic response of a perfect beam-column subjected to loading by axial stress waves was studied. Newton's method was used to solve the nonlinear equations iteratively and to determine the lateral displacement and axial strain as functions of time. An unstable linear approximation was used to start the iterative procedure, and to guide the search of the frequency domain for interesting nonlinear phenomena. The unstable linear solution was found to contain a periodic component of period 2T, where T = 4 tau and is the nondimensional transit time for the beam. The nonlinear response was dominated by a periodic resonance of period 0.9900 T, slightly less than half the period of the periodic component of the linear response function. Dissert. Abstr.

N77-11436 Polytechnic Inst of New York, Brooklyn.
WIND INDUCED VIBRATIONS OF SELF SUPPORTING CONICAL COLUMNS WITH END MASS Ph.D. Thesis
Louis Joseph Scerbo 1976 262 p
Avail: Univ. Microfilms Order No. 76-23443

A mathematical model is presented for predicting the wind induced vibrations of self-supporting, linearly tapered, truncated, conical columns with end mass. The columns considered can be made up of one or more linearly tapered uniform wall thickness sections, joined together to form a continuum. Their dynamic behavior is simulated by means of the Euler-Bernoulli bending differential equation, which is applicable for small deflections of variable cross section beams. This equation includes both the inertial and flexural behavior of the pole and neglects axial compression, rotational inertia, and shear deformation. These effects can be shown to be small for most practically designed towers. The aerodynamic and structural damping on and in the columns are assumed separable. This assumption simplifies the spatial differential equation such that solutions are expressible in terms of Bessel functions. Dissert. Abstr.

N77-11437# New Mexico Univ., Albuquerque.
DESIGN AND CONSTRUCTION OF AIRPORT PAVEMENTS ON EXPANSIVE SOILS Final Report, Apr. 1975 - Mar. 1976
R. Gordon McKeen Jun. 1976 179 p refs
(Contract DOT-FA75WAI-531)
(AD-A028094/1; CERF AP-18; FAA-RD-76-66) Avail: NTIS HC A09/MF A01 CSCL 13/2

A literature review was conducted to provide the best available techniques for designing airport pavements on expansive soils. Specific areas studied included indentification and classification systems, prediction of heave, setting of acceptable levels of heave, and the design of stabilized soil layers. Methods of identification and classification were found useful for qualitative purposes but unreliable for quantitative prediction of field rates of heave. A procedure is provided for the design of stabilized layers. Present design systems do not provide methods for designing volume changes; therefore, the influence of stabilizers on volume change behavior is not properly accounted for in this procedure. An outline of the research needed to develop a satisfactory design system is presented. The technology required is presently available, but a considerable effort is required to produce implementable methods. The approach recommended consists of establishing the load and moisture changes expected to occur at the site and evaluation of the soil response to those changes. Author

N77-11438# Toronto Univ. (Ontario).
LATERAL VIBRATIONS OF AN EXTENDING ROD
Miodrag S. Jankovic Apr. 1976 42 p refs Sponsored by the National Research Council of Canada
(UTIAS-TN-202; CN-ISSN-0082-5263) Avail: NTIS HC A03/MF A01

The dynamics of an extending rod are investigated. The contribution of the second mode to the deflection of a flexible rod during extension, is assessed and an approximate solution using the first and second mode is examined. As a prelude, the analysis of an extending pendulum is done because of the similarity with the case of an extending rod and because of its simplicity. This is equivalent in some sense to the one-mode representation in the rod case because its length changes in a similar manner to that of an extending rod. This allows certain techniques and concepts to be evaluated prior to the more challenging case which has an infinite number of degrees of freedom. There is no exact solution available for the pendulum with arbitrary extension rate, so certain approximations are examined. The resulting error is defined in nondimensional form, and plotted against nondimensional parameters to ensure generality of the analysis. The approximate analysis is then applied to the object of real interest - the extending rod. Author

N77-11439*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CYCLIC STRUCTURAL ANALYSIS OF AIR-COOLED GAS TURBINE BLADES AND VANES
Albert Kaufman and Raymond E. Gaugler 1976 30 p refs Presented at the Aerospace Eng. Conf., San Diego, Calif. 29 Nov. - 2 Dec. 1976 Sponsored by the Soc. of Automotive Eng.
(NASA-TM-X-73494; E-8892) Avail: NTIS HC A03/MF A01 CSCL 21E

The creep fatigue behavior of a fully impingement cooled blade for four cyclic cases was analyzed by using the Elas 55, finite element, nonlinear structural computer program. Expected cyclic lives were calculated by using the method of strainrange partitioning for reversed inelastic strains and time fractions for ratcheted tensile creep strains. Strainrange partitioning was also applied to previous results from a one dimensional cyclic analysis of a film impingement cooled vane. The analyses indicated that strainrange partitioning is more applicable to a constrained airfoil such as the film impingement cooled vane than to the relatively unconstrained fully impingement cooled airfoil. Author

N77-11440*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
ON THE ELASTIC STABILITY OF SHELLS
Wilfred H. Horton [1976] 85 p refs
(Grant NGL-11-002-096)
(NASA-CR-145088) Avail: NTIS HC A01/MF A01 CSCL 20K

The instability of axially compressed cylindrical shells is investigated to devise nondestructive methods of evaluation. Tests were made on small scale plastic vehicles and on large realistically reinforced aluminum alloy circular cylinders. Probing

methods were used to determine the locations of weakness, and pertinent instability load levels were devised. M.C.F.

N77-11441# Schweizerischer Verband fuer die Materialpruefung der Technik (SVMT), Duebendorf (Switzerland).
MECHANISM OF MATERIAL FATIGUE DURING THE CRACK INITIATION STAGE [ZUM MECHANISMUS DER MATERIALERMUEDUNG IM VOR-RISS-STADIUM]
J. Branger and E. Steinheil 1976 19 p refs In GERMAN
(ICAF-DOC-895) Avail: NTIS HC A02/MF A01

Full scale fatigue tests by fatigue-history loading were performed with the aim to fly military A/C up to the limit of their structural capacity and to extend the service life by statistical fatigue tests of a critical safe-life element. The first analyses of fatigued light alloy specimens revealed in surface layers down to about 30 nm concentrations of metal hydroxides, increasing with increasing fatigue straining. Similar concentrations were analyzed in steel specimens. Author

N77-11442*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RIM-SPOKE COMPOSITE FLYWHEELS: STRESS AND VIBRATION ANALYSIS
Christos C. Chamis and Louis J. Kiraly Washington Nov. 1976 21 p ref Presented at 1975 Flywheel Technol. Symp., Berkeley, Calif., 10-12 Nov. 1975
(NASA-TN-D-8339; E-8657) Avail: NTIS HC A02/MF A01 CSCL 20K

Elementary relations are described to determine the material utilization efficiency of a thin wall rim composite flywheel over other configurations. An algorithm is generated for the automatic selection of the optimum composite material for a given thin rim flywheel environment. Subsequently, the computer program NASTRAN is used to perform a detailed stress and vibration analysis of thin wall cylindrical shell rim spoke, single rim and multirim composite flywheels for a specific application. Author

N77-11443# Adelaide Univ. (Australia). Dept. of Applied Mathematics.
ON BUCKLING OF VISCOELASTIC PLATES
J. S. Hewitt and J. Mazumdar 31 Dec. 1975 29 p refs Backup document for AIAA synoptic scheduled for publication in AIAA journal, Mar. 1977
Avail: NTIS HC A03/MF A01

The buckling of viscoelastic plates of arbitrary geometry is studied using a method based on the concept of contour lines of equal deflection on the surface of the plate. Two ordinary differential equations governing respectively the time behavior and the spatial behavior of the plate are derived. For illustrative purpose, the problems of a clamped rectangular plate and a clamped semicircular plate are discussed. Author

N77-11444# Bettis Atomic Power Lab., West Mifflin, Pa.
THREE-DIMENSIONAL FINITE ELEMENT ANALYSIS OF A LARGE CIRCULAR DISC WITH CIRCULAR PENETRATIONS
J. L. Gordon Jan. 1976 178 p refs
(Contract E(36-1)-GEN-14)
(WAPD-TM-1206) Avail: NTIS HC A09/MF A01

A three-dimensional finite element temperature, deflection, and stress analysis of a large thick disc containing four circular penetrations is presented. Electrical heaters within each penetration increased the surface temperatures of the penetrations at programmed rates. The measured thermal patterns and thermally induced displacements and strains are compared with the analysis results. Correlation between experimental and analytical results is generally good. Also provided are general guidelines to be employed in modeling. Author (ERA)

N77-11445# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
APPLICATION OF DESIGN DATA DERIVED FROM FATIGUE TESTS WITH SERVICE-LIKE LOAD SEQUENCES FOR LIFE PREDICTION
D. Schuetz and H. Lowak 16 Feb. 1976 61 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung
(LBF-FB-109/76) Avail: NTIS HC A04/MF A01; Lab. fuer Betriebsfestigkeit, Darmstadt, West Ger. DM 38

Reliable life curves were established for a load sequence and a cumulative frequency distribution, which are typical at the wing structure of transport aircraft. The life estimation for details subjected to load spectra varying from that applied to the specimens were demonstrated using the Relative Miner's rule. It was found that for large differences between the test load and the design load spectra the Relative Miner's rule is not advantageous. As the difference between the estimated life based on the Relative Miner's rule and the corresponding tests results could to a large extent be explained by the action of residual stresses, a suitable correction was introduced. The correction was applied to the specimens of this investigation using empirically derived data. The results proved an effective refinement of the Relative Miner's rule leading to very accurate life predictions. Author (ESA)

N77-11446# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
SIGNIFICANCE OF MEASURED LOCAL STRAINS FOR THE FATIGUE STRENGTH OF JOINTS
J. J. Gerharz and D. Schuetz 16 Feb. 1976 53 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung
(LBF-FB-128/76) Avail: NTIS HC A04/MF A01; Lab. fuer Betriebsfestigkeit, Darmstadt, West Ger. DM 36

Strains were measured with strain gages at filled holes of joints: clamping force, fit, and load transfer were varied. The gages were arranged to determine the effects of these parameters and parameter combinations on the local strain and stress and thus on the fatigue strength on the joint. In addition to the local stresses the amounts of secondary bending and load transfer were calculated and their interaction with clamping force and fit established. Fatigue strength related influence factors were determined by the local stresses occurring during a load cycle and compared with empirically derived factors. Author (ESA)

N77-11447# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
COMPILATION OF MEASURES TO INCREASE THE FATIGUE STRENGTH OF AIRCRAFT STRUCTURES
D. Schuetz and J. J. Gerharz 5 Nov. 1975 96 p refs In GERMAN; ENGLISH summary
(LBF-TB-126/75) Avail: NTIS HC A05/MF A01; Lab. fuer Betriebsfestigkeit, Darmstadt, West Ger. DM 42

The compilation is the result of a literature survey and was made to comprehensively inform the designer and to facilitate the selection of suitable measures for a fatigue critical structural detail. Together with the description of the measures, improvement factors are presented which should be used only as lead values. A total of 40 compilations of structures such as eye rods, open holes, and riveted screw joints are presented. Author (ESA)

N77-11448# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.
FRACTURE TOUGHNESS TESTS ON COMPRESSIVE PRELOADED SPECIMENS WITH A THICKNESS OF 5 mm
A. H. LaCrois 2 Jan. 1975 29 p
(FOK-R-1839) Avail: NTIS HC A03/MF A01

Fracture toughness specimens of four different materials, i.e., 7075-T6, 2024-T3, RR58-T6, and 5456-H323 (aluminum alloys), thickness 5 mm, were preloaded in compression and in fatigue. The K sub Q values were compared in order to determine the compressive preload which results in the same fracture toughness as for fatigue preloaded specimens. Conclusions of R-1743 and R-1774 were confirmed. A linear correlation between the 'compressive K' with which the specimens have to be loaded and the yield strength seems to exist. Author (ESA)

N77-11449# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.
FRACTURE TOUGHNESS OF 8mm 2024-T3 NON CLAD PLATE WITH LONG CENTRAL CRACKS
A. H. LaCrois 2 Jun. 1975 9 p
(FOK-R-1879) Avail: NTIS HC A02/MF A01

Fracture toughness tests were carried out with center notched specimens of 8 mm 2024-T3 non clad plate to predict

the fail safe properties of laminated airbus links. A K-value (fracture toughness) of 142 kgf x mm to the 3/2th power was established using the Feddersen method. The Feddersen method for presenting fracture toughness test results is briefly described. ESA

N77-11450# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

CALCULATION OF VIBRATION MODES AND RESONANCE FREQUENCIES OF THE NORTHROP NF-5

H. H. Ottens 15 Apr. 1975 71 p refs Supersedes NLR-TR-74012-U Sponsored by Directorate of Mater. Air, RNLAF

(NLR-TR-75050-U; NLR-TR-74012-U) Avail: NTIS HC A04/MF A01

A calculation of global values of resonance frequencies, vibration modes, and generalized masses was made for the Northrop NF-5 in order to investigate the potentialities of both the finite element method and the component mode method in obtaining these characteristics. The configurations considered involve full tiptanks, 70 lbs stores at the outboard pylons, full or empty 275 USG tanks at the inboard pylons, and a 150 USG tank at the center line pylon. For these configurations, a comparison was made with ground vibration test results. ESA

N77-11451# Sydney Univ. (Australia). Civil Engineering Labs.

CRACKING IN CONCRETE: ATTRIBUTED TO DEFECTS IN CONSTRUCTION

Allen D. Campbell and H. L. Helffenstein Jan. 1976 27 p refs

(PB-252920/4; R-279) Avail: NTIS HC A03/MF A01 CSCL 13C

As part of a project aimed at reducing cracking in concrete, a number of cases of cracking were examined where the defects could be attributed to construction or supervision deficiencies. Cases are examined under the general headings of cracking caused by steel corrosion, plastic cracking and construction procedures. The cases all show that supervision of construction is a necessary part of ensuring that structures shall be crack-free or that cracking, if it does take place, occurs only to an acceptable extent. GRA

N77-11452# Massachusetts Inst. of Tech., Cambridge. Constructed Facilities Div.

EXAMPLES OF PRESSURE COEFFICIENTS MEASURED ON A TALL BUILDING

Frank H. Durgin, Robert J. Hansen, Thomas G. Harmon, and John T. Strawbridge Feb. 1976 15 p

(Grants NSF GK-35305; NSF GK-37072)

(PB-252416/3; R76-11) Avail: NTIS HC A02/MF A01 CSCL 13M

Data on average, rms and peak pressure coefficients for eight pressure sensors located in three separate regions of the facade of a tall modern building are presented for twelve, twenty-minute consecutive time periods in two recent modest wind storms. Four of the sensors are located in a turbulent region, and data are presented for these sensors in one storm. Data from a second group of sensors, three in a region of separated flow, and one in a relatively quiescent region of the facade, are presented for another storm. Details of the instrumentation system are given. Pressure coefficients are referenced to a velocity measured 100 ft. above the roof of the building, which is 790 feet tall. GRA

N77-11453# British Steel Corp., Sheffield (England). Information Services.

THE DEVELOPMENT OF STEEL PLATE FOR OFFSHORE STRUCTURES

D. C. Shenton and J. M. Arrowsmith Apr. 1976 18 p refs

(PB-254195/1; GS/PROD/MISC/116/75/C) Avail: NTIS HC A02/MF A01 CSCL 13M

The requirements for plate to be fabricated into node joints are particularly onerous. The main one is insusceptibility to lamellar tearing. This is assessed on a quality control basis by short transverse (through-thickness) tensile testing, the criterion being a minimum ductility as measured by reduction of cross-section area. The development of steel plate to meet these requirements has involved detailed metallographic investigation of nonmetallic inclusions present with the object of determining the mechanism whereby they impair ductility. By identifying the sources of inclusions further improvements were made to deoxidation and casting practices. High quality plate with short transverse ductility guarantees and with resistance to lamellar tearing is now available. GRA

N77-11454# California State Dept. of Transportation, Sacramento.

FOLLOW-UP STUDY FOR THE CALIFORNIA RESILIENCE DESIGN METHOD Final Report, Dec. 1966 - Dec. 1975

Donald V. Roberts, Roy W. Bushey, and James A. Matthews Feb. 1976 96 p refs Prepared in cooperation with Federal Highway Admin., Washington, D.C.

(PB-255121/6; CA-DOT-TL-3317-1-76-19) Avail: NTIS HC A05/MF A01 CSCL 13B

California's research efforts to develop and implement a structural design method for flexible pavement sections overlying untreated bases and resilient basement soils are described. Predicted deflections are compared to previously developed tolerable deflection levels for varying asphalt concrete thicknesses and traffic indexes. When predicted deflection values exceed tolerable deflections, an additional increment of subbase or base material is designed to reduce predicted deflection values to tolerable levels. The resilience test equipment used to determine potentially resilient soils is described along with the mobile equipment, Deflectometer and Dynaflect, used to measure deflections on the as built pavements. GRA

N77-11455# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

COMPARISON OF 4-1/2- AND 7-IN. (6-IN. NOMINAL) MAXIMUM SIZE AGGREGATE MIXTURES FOR NEW LOCK AND DAM NO. 26, MISSISSIPPI RIVER Final Report

William O. Tynes Apr. 1976 20 p ref

(AD-A023968; WES-MP-C-76-1) Avail: NTIS HC A02/MF A01 CSCL 13/2

Three sets of concrete mixtures were proportioned with each of the three water-cement (W/C) ratios: 0.5, 0.7, and 0.8 by weight of cement plus pozzolan. Each set consisted of two mixtures, one containing 4-1/2-in. and the other one 7-in. (6-in. nominal) maximum size aggregate (MSA). The slump of each mixture was 1-1/2 plus or minus 1/2 in., and the air content was 5.0 plus or minus 1 percent on the minus 1-1/2-in. portion of the mixtures. Two batches of concrete were made for each mixture with a 0.7 and 0.8 W/C ratio, and one batch was made for each mixture with a 0.5 W/C ratio by weight. Six- by twelve-in. cylindrical specimens were cast and tested for strength at 28, 90, and 365 days age, and block specimens 3 by 3 by 1.5 ft were made to compare workability. GRA

N77-11456# Air Force Academy, Colo. Research Lab.

VALIDATION OF SOIL STABILIZATION INDEX SYSTEM WITH MANUAL DEVELOPMENT

David D. Currin, John J. Allen, and Dallas N. Little Feb. 1976 567 p refs

(AF Proj. 7903)

(AD-A024549; FJSRL-TR-76-0006) Avail: NTIS HC A24/MF A01 CSCL 13/2

Contents: Soil sample suite; Soil stabilization with cement; Soil stabilization with lime; Soil stabilization with asphalt; Performance benefits of stabilized pavement layers; When to use stabilization; Residual strength requirements for stabilized layers. GRA

N77-11457# California State Dept. of Transportation, Sacramento. Transportation Lab.

CONCRETE AGGREGATE DURABILITY TESTS Final Report

D. L. Spellman, J. H. Woodstrom, and S. N. Bailey Dec. 1975 45 p refs Sponsored by the Fed. Highway Admin.

(PB-255436/8; CA-DOT-TL-3476-2-75-44) Avail: NTIS HC A03/MF A01 CSCL 14B

Several procedures are studied in an attempt to develop a less time consuming substitute for the sodium sulfate soundness test. Considered were procedures using elastic fractionation, heavy media separation, autoclave degradation, freezing and thawing of aggregates, and others. One procedure, detrition value test, correlates fairly well with soundness test losses for aggregates from one area of the state where the soundness test is a controlling

factor in aggregate processing. This procedure consists of the dynamic abrasion of water and aggregate in a 5 gallon bucket on a paint shaker. A test method was developed and an alternate specification to the soundness test requirement written for control of aggregate quality. The specification is currently limited to aggregates from the Santa Clara River area near Ventura. GRA

N77-11458# Naval Civil Engineering Lab., Port Hueneme, Calif.
DEVELOPMENT OF A COMPUTER PROGRAM FOR THE DYNAMIC NONLINEAR RESPONSE OF REINFORCED CONCRETE SLABS UNDER BLAST LOADING Final Report, May - Sep. 1975
J. M. Ferritto Apr. 1976 56 p refs
(AD-A024050; CEL-TN-1434) Avail: NTIS HC A04/MF A01 CSCL 19/1

A computer program was developed to determine the nonlinear dynamic response of reinforced concrete slabs subjected to blast pressure loading. Given the explosive parameters and geometry of the slab, the program computes the blast environment and the structural resistance, mass, and stiffness of the slab and solves for the dynamic response. The program will assist engineers in the design and analysis of facilities intended to contain the effects of accidental explosions. The report gives a user's guide and sample problems with data input and program output. Author (GRA)

N77-11459# National Bureau of Standards, Washington, D.C. Center for Building Technology.
STRUCTURAL PERFORMANCE OF MASONRY WALLS UNDER COMPRESSION AND FLEXURE Final Report
S. G. Fattal and L. E. Cattaneo Jun. 1976 66 p refs Sponsored in part by Army, Navy and AF
(PB-255075/4; NBS-BSS-73; LC-75-619305) Avail: NTIS HC A04/MF A01 CSCL 13M

Ninety-five prisms and fifty-six walls of brick concrete block and composite brick and block masonry construction were tested under various combinations of compressive and transverse loads. Constitutive relations for masonry are developed from test results. By using rational analysis it is shown that prism strength can be predicted on the basis of linear behavior at failure. It is also shown that wall strength can be predicted on the basis of prism strength when an appropriate allowance is made for the effect of wall slenderness on sectional capacity. GRA

N77-11460# California Univ., Los Angeles. Dept. of Materials.
ACOUSTIC EMISSION TESTING FOR STRUCTURAL APPLICATIONS
Kanji Ono and Allen T. Green (Acoustic Emission Technol. Corp., Sacramento, Calif.) Mar. 1976 12 p refs Presented at ASCE Specialty Conf./UCLA Extension, Los Angeles, 30-31 Mar. 1976
(Contract N00014-75-C-0419)
(AD-A024064) Avail: NTIS HC A02/MF A01 CSCL 13/13

General introduction of acoustic emission testing is given. While little practical experience has been accumulated in many applications involving civil engineering structures, the potential of this technique in structural integrity assessment has been well demonstrated in aerospace and nuclear fields. Further developmental efforts should aid in realizing the full benefit of this method. Author (GRA)

N77-11461# Naval Civil Engineering Lab., Port Hueneme, Calif.
REVISED AIRCRAFT LOAD CURVES AND VEHICLE ICE-THICKNESS TABLES FOR ANNUAL ICE SHEET OPERATIONS NEAR MCMURDO, ANTARCTICA Final Report, Sep. 1974 - Jun. 1975
K. D. Vaudrey Apr. 1976 23 p refs
(AD-A024051; CEL-TN-1431) Avail: NTIS HC A02/MF A01 CSCL 08/12

Updated aircraft load curves and vehicle ice-thickness tables are presented for operations on the sea-ice sheet near McMurdo Station, Antarctica. First, material property research on sea-ice is reviewed to demonstrate the current knowledge of ice-sheet bearing strength. Then the elastic finite element computer code is discussed: how it models an ice sheet and accepts material property and loading condition parameters. The load curves and ice-thickness tables give minimum ice-sheet thicknesses for specified aircraft and vehicle weights over four seasonal periods during the operating season. In addition to the tables and curves, operational field procedures are included to provide guidance for both day-to-day monitoring of the ice sheet and visual observation of ice-sheet behavior. Author (GRA)

N77-11462# Utah Dept. of Transportation, Salt Lake City. Research and Development Unit.
IMPROVEMENT OF UTAH'S FLEXIBLE PAVEMENT PERFORMANCE SYSTEM Final Report
Douglas I. Anderson, Dale E. Peterson, and L. Wayne Shepherd Mar. 1976 98 p refs Prepared in cooperation with Federal Highway Administration, Washington, D.C.
(PB-254819/6; UDOT-MR-76-1; Utah-RR-500-925) Avail: NTIS HC A05/MF A01 CSCL 13B

The terminal serviceability relationship was revised to consider not only functional class but also average daily traffic. Parameters related to the shape of the deflection basin were reviewed, and the spreadability chart was incorporated into the system. A method to correct deflection data for temperature variations was adopted. The procedure considers the temperature history, surface temperature, pavement thickness, and the time of day of testing. A computerized pavement evaluation system was developed to aid maintenance personnel in making the most appropriate pavement rehabilitation decision. Priority listings are generated for maintenance relating to the pavement condition parameters; structural adequacy, distress, serviceability, and skid. GRA

N77-11463# Rice Univ., Houston, Tex. Dept. of Mechanical Engineering.
NUMERICAL DETERMINATION OF MINIMUM MASS STRUCTURES WITH SPECIFIED NATURAL FREQUENCIES Interim Report
A. Miele 1976 20 p refs
(Grant AF-AFOSR-2185-72; AF Proj. 9749)
(AD-A023655; AFOSR-76-0275TR) Avail: NTIS HC A02/MF A01 CSCL 13/13

The problem of the axial vibration of a cantilever beam is investigated numerically. The mass distribution that minimizes the total mass for a given fundamental frequency constraint is determined using both the sequential gradient-restoration algorithm and an ad hoc modification of the modified quasilinearization algorithm. Author (GRA)

N77-11464# Southwest Research Inst., San Antonio, Tex.
ADDITIONAL ENERGY SOLUTIONS FOR PREDICTING STRUCTURAL DEFORMATIONS Technical Report, Sep. 1974 - Jul. 1975
P. S. Westine and P. A. Cox Nov. 1975 33 p refs
(Contract DAAA15-75-C-0083)
(AD-A024591; EM-CR-76031; TR-4) Avail: NTIS HC A03/MF A01 CSCL 13/13

Revised and newly developed formulas for prediction of plastic deformations of structural elements in suppressive structures are presented in this report. These equations give improved agreement with literature, data and solutions for more structural elements than previous reports. GRA

N77-11465# Forest Products Lab., Madison, Wis.
HARDBOARD-WEBBED I-BEAMS SUBJECTED TO SHORT-TERM LOADING
M. J. Superfesky and Terry J. Ramaker 1976 15 p refs
(AD-A024507; FSRP-FRL-264) Avail: NTIS HC A02/MF A01 CSCL 13/13

The performance of structural I-beams and box beams is highly dependent on the shear properties of the web materials. Some wood-base panel materials such as hardboard possess shear properties that indicate a good potential for such applications. Reports of the performance of hardboard-webbed I-beams are encouraging, although specific information necessary for design and for predicting their behavior is scarce. Also, the effects of two important factors, long-term loading and loading environment, have not been fully determined. This research expanded previous work conducted at the Forest Products Laboratory by including the effect of other important factors, such as mode of failure (as affected by span length) and type of web material, and by providing additional data. In addition, data will serve as a base for judging the effects of long-term loading and loading environ-

ment on similar I-beams made from the same lot of material. Results indicate that the behavior of hardboard-webbed I-beams subjected to short-term loading can be predicted reasonably well using fundamental engineering theory together with the properties determined from small specimen evaluations. Author (GRA)

N77-11466# Illinois State Dept. of Transportation, Springfield. Bureau of Materials and Physical Research.

HIGHWAY INSULATING MATERIAL EVALUATION Final Report, Oct. 1972 - Apr. 1975

Indalecio Mascunana Mar. 1976 33 p Prepared in cooperation with the Federal Highway Admin., Washington, D.C.

(PB-254792/5; ILL-PR-64) Avail: NTIS HC A03/MF A01 CSCL 13C

An expanded perlite-asphalt hot mix insulating sub base was used to control frost penetration of the subgrade in a full scale highway construction project over a period of five years. Conclusions and recommendations concerning use of the material in highway construction and highway maintenance are presented. The first half of the study was published in an interim report in October 1973. Field data for the last three years are included in this report. Results of the study indicated that four inches of AWC (24 pcf density) subbase under 10-inch PCC pavement, was effective in preventing penetration of freezing subsurface temperatures and frost action in the subgrade in northern Illinois. GRA

N77-11467# Denver Research Inst., Colo. Div. of Mathematical Sciences.

AN INVERSE METHOD FOR DETERMINING SMALL VARIATIONS IN PROPAGATION SPEED

Norman Bleistein 20 Apr. 1976 31 p refs

(Contracts N00014-76-C-0039; N00014-76-C-0079; NR Proj. 083-364; NR Proj. 041-434)

(AD-A025296; MS-R-7615) Avail: NTIS HC A03/MF A01 CSCL 20/14

The inverse problem of determining small variations in propagation speed from observations of signals which pass through the medium of interest and are then observed remotely is considered. That the variation satisfies an integral equation of integral transform type with an atypical kernel is shown. In a variety of examples for the scalar and vector wave equation (Maxwell's equations) and the equations of linear elasticity, this integral equation is solved by elementary means. GRA

N77-11468# Gillette Research Inst., Inc., Rockville, Md.

TECHNOLOGY FOR USING SULFATE WASTE IN HIGHWAY CONSTRUCTION Final Report

L. M. Smith, A. Kawam, A. Whitcraft, H. G. Larew (Virginia Univ., Charlottesville), F. McCormick (Virginia Univ., Charlottesville), and L. C. Rude (Virgina Univ., Charlottesville) Dec. 1975 212 p refs

(Contract DOT-FH-11-8122)

(PB-254815/4; FHWA-RD-76-31) Avail: NTIS HC A10/MF A01 CSCL 13C

Mixtures of fly ash, lime and sulfate waste were examined for their potential use in highway construction. During this initial phase of the project, variables such as fly ash source, form of calcium sulfate lime type, mixture consistency, curing temperature, admixtures and impurities expected in waste sulfates were examined. Also, studies of compound development in selected mixtures were performed. The second phase of the study was designed to obtain strength-compositional relationships for samples prepared with actual waste sulfates. These waste sulfates included neutralized acid mine drainage, titangypsum, hydrofluoric acid by-product, gas scrubber waste and neutralized steel pickling liquor. Results were used for the selection of mixtures for engineering evaluation. These mixtures were examined for compressive and tensile strength, freeze/thaw resistance, wet/dry stability, California bearing ratio, permeability and leachability. GRA

N77-11469# Georgia Dept. of Transportation, Forest Park. Office of Materials and Research.

RIGID PAVEMENT JOINTS AND SEALANTS STUDY Final Report, Sep. 1970 - Sep. 1975

J. B. Thornton Sep. 1975 133 p refs Prepared in cooperation with the Federal Highway Admin., Washington, D.C.

(PB-254806/3; FHWA-RD-76-S0481) Avail: NTIS HC A07/MF A01 CSCL 13B

A study is reported which was initiated to evaluate the relative performance of a number of different types of rigid pavement joint sealants. The project was designed to provide information on the effect that several joint variables might have on the performance of the joint sealant design. These design variables include joint spacing and orientation (skewed or square) as well as sealant design properties. The equipment and procedures used in establishing the test locations and obtaining performance data are described. The report contains a detailed discussion on each type of sealant used as well as installation procedures and problems. In addition, cost estimates for each type of sealant and installation were furnished by the contractor and are tabulated. GRA

N77-11470# Northern Arizona Univ., Flagstaff. Coll. of Engineering and Technology.

POLYMER PAVEMENT CONCRETE FOR ARIZONA STUDY 2 Final Report

Sandor Popovics Mar. 1976 146 p Sponsored by FHWA

(PB-255692/6; FHWA-AZ-RD-74(154)) Avail: NTIS HC A07/MF A01 CSCL 13C

The most important result of this investigation is the development of the addition of urea-formaldehyde combinations in the form of a monomer system to the mixing water of Portland cement mortars and concretes. Although the addition of this system to concretes produced only negligible strength increases, experimental data indicated that several combinations of the same system with mortars produced compressive strength increases of 1,500 to 2,500 psi. It is not clear at this time why the urea-formaldehyde monomer system is effective in mortars and ineffective in concretes. Further investigation is needed to improve the effectiveness of this monomer system in concretes, too. The application of such a monomer system is advantageous from an economical standpoint because this is the least expensive form of the urea-formaldehyde combinations, and because the technology of such monomer systems in mortars and concretes is simple. Several other directions were also investigated, such as the optimization of the basic urea-formaldehyde prepolymers, acidic urea-formaldehyde prepolymers, and several other chemical systems and commercially available polymers. Some of these systems did produce strength increases, but these were not high enough. GRA

N77-11471# National Bureau of Standards, Washington, D.C. Center for Building Technology.

ANALYSIS OF REINFORCED CONCRETE BEAMS SUBJECTED TO FIRE Final Building Science Series

Bruce Ellingwood and James R. Shaver Jul. 1976 86 p refs

(PB-256425/0; NBS-BSS-76; LC-76-608159) Avail: NTIS HC A05/MF A01 CSCL 13L

Methods for analytically predicting the behavior of simply supported reinforced concrete beams subjected to fire are presented. This is generally a two-step process involving a thermal analysis followed by a stress analysis. This study emphasizes the latter, wherein the determination of moment-curvature-time relationships for the beam cross section incorporates the temperature-dependent strength degradation in the steel and concrete as well as thermal and creep strains. The sensitivity of the predictions to various phases of analytical modeling is investigated to establish the parameters most important for the prediction of beam behavior and to indicate where additional data should be gathered. A comparison of predicted behavior with that observed in fire tests shows excellent agreement when realistic reinforcement temperature histories are used. GRA

N77-11472# California State Dept. of Transportation, Sacramento. Transportation Lab.

ACCELERATED TEST DEVELOPMENT FOR PORTLAND CEMENT CONCRETE Final Report

S. N. Bailey and B. F. Neal Apr. 1976 63 p refs Sponsored by FHWA

(PB-255714/8; CA-DOT-TL-5182-1-75-22; Rept-635182) Avail: NTIS HC A04/MF A01 CSCL 13C

A satisfactory accelerated concrete strength test method was developed. The method, called 'autogenous curing', consists of placing a fresh 6 x 12-inch concrete cylinder in an insulated

enclosure for a 48-hour curing period, then testing for compressive strength. The developed 48-hour compressive strengths are 40 to 75 percent of the 28-day standard moist cured compressive strengths. This method can be used for concrete quality control and acceptance. In the laboratory, a series of tests were designed to determine the magnitude and direction that changes in cement quality and types, aggregates, temperature, and admixtures would have on the correlation between the 48-hour cure strength and the 28-hour standard moist cured strength. Analyses of the data indicated that a new strength correlation curve should be established when any changes are made in the concrete. GRA

N77-11473# Illinois Univ., Urbana. Dept. of Civil Engineering.

BOND CHARACTERISTICS OF MODEL REINFORCEMENT

Nancy L. Gavlin Apr. 1976 45 p refs

(Grant NSF ATA-74-22962)

(PB-255847/6; Ser-427) Avail: NTIS HC A03/MF A01 CSCL 13C

The bond characteristics of no. 8 gage steel reinforcing wire embedded in small-scale concrete was studied. The investigation included a total of seven series of pull-out tests, with eight pull-out specimens tested per series. GRA

N77-11474# Naval Ship Research and Development Center, Bethesda, Md.

APES: SECOND GENERATION TWO-DIMENSIONAL FRACTURE MECHANICS AND STRESS ANALYSIS BY FINITE ELEMENTS

L. Nash Gifford, Jr. Dec. 1975 83 p refs

(SF43422502)

(AD-A025217; DTNSRDC-4799) Avail: NTIS HC A05/MF A01 CSCL 20/11

Computer program APES utilizes a high order isoparametric finite element and two different singular crack tip elements. It can treat elastic axisymmetric, plane strain, or plane stress problems and is particularly valuable for stress concentration problems and linear fracture mechanics applications. The behavior characteristics of the finite elements are given, and abundance of case studies are included, and detailed preparation of input data is described. Thus the report will enable the designer/analyst to immediately put the program to practical use. It is shown that accurate stress intensity factors for cracked structures under combined Modes I and II loading conditions are calculated directly and need not be inferred later. The manpower associated with finite element analysis is reduced by an order of magnitude, and the accuracy of the method is significantly increased. It is demonstrated that elastic planar and axisymmetric stress and fracture mechanics analysis can now be performed quickly, inexpensively, and very accurately for highly complex structures in a manner that is appealingly simple. This work has direct application to fatigue and fracture problems in which the behavior of full-scale structural details is predicted on the basis of the behavior of simple, controlled laboratory specimens.

Author (GRA)

N77-11475# Transportation Research Board, Washington, D.C.

OPTIMIZING THE USE OF MATERIALS AND ENERGY IN TRANSPORTATION CONSTRUCTION

1976 81 p refs Proceedings held at Washington, D. C., 12-14 Nov. 1975 Sponsored by FEA, FHWA, and ERDA

(PB-253713/2; TRB/SR-166; ISBN-0-309-02477-3) Avail: NTIS HC A05/MF A01 CSCL 13C

These proceedings include the papers by the 4 keynote speakers who emphasized the following: the energy crisis is real and serious; how energy implications can affect roadway decision making; the construction materials situation and where materials may be in short supply; and one contractor's view of how energy and materials can be optimized. These papers are followed by the reports of the 7 topics chairmen, a general discussion, and suggestions from state transportation agencies on ways to minimize the impact of energy and material shortages. GRA

N77-11476# Texas Transportation Inst., College Station.

THERMAL ACTIVITY OF BASE COURSE MATERIAL RELATED TO PAVEMENT CRACKING Research Report, Sep. 1972 - Dec. 1975

Samuel H. Carpenter and Robert L. Lytton Dec. 1975 128 p refs Sponsored by the Texas State Dept. of Highways and Public Transportation, Austin Prepared in cooperation with the Federal Highway Admin.

(PB-254754/5; TTI-2-8-73-18-2; FHWA-RD-S0478) Avail: NTIS HC A07/MF A01 CSCL 13C

An initial computer study using a heat transfer program showed that freeze-thaw activity during a winter, for Perryton, Texas, was centered mainly in the base course for a typical pavement. Comprehensive freeze-thaw testing showed the base course to be more active, thermally, than asphaltic concrete. The thermal activity is composed of a freeze deformation and a residual deformation. Both quantities are related to the soil moisture suction of the material. The soil moisture suction which develops in a sample is a function of the grain size, moisture, pore structure and clay mineralogy. Clay mineralogy determinations were done using X-ray diffraction to obtain the relative percentages of the clay minerals present. A direct relationship is established between the freeze deformation and clay mineralogy of the material tested. The data also demonstrate the validity of using clay mineralogy properties as a design quantity for base course material. GRA

N77-11477# Purdue Univ., Lafayette, Ind.

THE INFLUENCES OF RETARDING ADMIXTURES ON VOLUME CHANGES OF CONCRETE Final Summary Report

Charles F. Scholer 1 Oct. 1975 35 p ref Prepared in cooperation with the Federal Highway Admin. Sponsored by the Indiana State Highway Commission

(PB-254929/3; JHPR-75-21) Avail: NTIS HC A03/MF A01 CSCL 13C

Concrete specimens were prepared to evaluate the long term drying shrinkage of the proprietary admixtures which had been evaluated as pastes. Long term shrinkage of concrete was not appreciably affected by the admixtures tested. Plastic drying shrinkage of paste was evaluated from the completion of mixing until approximately initial set. The proprietary varieties of admixtures were used in this investigation. The amount of plastic shrinkage varied with the variety of admixture, and an interaction was found between admixture variety and drying condition (humidity). (GRA)

N77-11478# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

CURRENT PRACTICE ON ESTIMATING CRACK GROWTH DAMAGE ACCUMULATION WITH SPECIFIC APPLICATION TO STRUCTURAL SAFETY DURABILITY AND RELIABILITY Final Report, 15 Jan. - 15 Mar. 1975

Howard A. Wood, Joseph Gallagher, Robert M. Engle, and John M. Potter Jan. 1976 67 p refs

(AF Proj. 1367)

(AD-A025499; AFFDL-TR-75-32) Avail: NTIS HC A04/MF A01 CSCL 11/6

This report provides a brief summary of current practice on predicting crack growth damage accumulation with specific applications to current USAF policies on Safety and Durability. Analytical procedures are required to determine safe crack growth-life intervals and to estimate economic limits of crack growth. Reliability and risk analyses are discussed to illustrate their impact on structural decisions. The life prediction methodology will be examined to illustrate the major effects of the structural parameters (geometry), the material parameters (basic crack growth rate) and loading (usage patterns). Examples are cited to give indication of confidence in making life predictions. A summary of procedures for estimating service loads and chemical-thermal environments is included as they relate to simulating usage effects in the laboratory. GRA

N77-11479# Southwest Research Inst., San Antonio, Tex.

ESTIMATES OF BLOWDOWN OF QUASI-STATIC PRESSURES IN VENTED CHAMBERS Technical Report, Jan. - Mar. 1975

W. E. Baker and G. A. Oldham Aberdeen Proving Ground, Md. Edgewood Arsenal Nov. 1975 19 p refs

(Contract DAAA15-75-C-0083)

(AD-A025502; EM-CR-76029; TR-2) Avail: NTIS HC A02/MF A01 CSCL 19/4

This report presents recent analyses, and fits of experimental data to scaled parameters, for blowdown pressures in vented chambers. Theoretical predictions are made for time histories of blowdown pressures, and a scaling law is presented. Limited comparisons are made with experiment. GRA

N77-11480# Southwest Research Inst., San Antonio, Tex.
ESTIMATING EXTERNAL BLAST LOADS FROM SUPPRESSIVE STRUCTURES Technical Report, Sep. 1974 - Jul. 1975
E. D. Esparza Aberdeen Proving Ground, Md. Edgewood, Arsenal Nov. 1975 17 p refs
(Contract DAAA15-75-C-0083)
(AD-A025503; EM-CR-76030; TR-3) Avail: NTIS HC A02/MF A01 CSCL 19/4

This report describes methods for predicting blast overpressure outside suppressive structures. Prediction curves are in scaled form. Data are compared to free-field data for large high-explosive detonations on the ground. GRA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N77-11481*+ National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT 2: CUMULATIVE NON-US STANDARD CATALOG, 1975 - 1976
1976 1412 p
(NASA-TM-X-74212; GSFC/LNI/2-76/1) Avail: NTIS HC A99 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The Non-U.S. Standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Author

N77-11482*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT 2: CUMULATIVE US STANDARD CATALOG, 1975 - 1976
1976 880 p
(NASA-TM-X-74217; GSFC/LUI/2-76/1) Avail: NTIS HC A99 CSCL 05B

For abstract, see N77-11481.

N77-11483 Pennsylvania Univ., Philadelphia.
A SYSTEMATIC APPROACH TO OPERATIONAL SCHEDULING FOR INFORMATION COLLECTION SYSTEMS Ph.D. Thesis
David Sims 1976 357 p
Avail: Univ. Microfilms Order No. 76-22783

A systematic methodology is presented which enables one to construct and solve a large scale linear zero-one mathematical programming model of an information collection system. The parameters of this model define the system's operational capability, its resources, its management's operational philosophy, and its users' desires. The solution to this model specifies the system's optimum operational schedule. The presented methodology is employed to formulate a computerized scheduling process for the Earth Resources Technology Satellite system. This process is termed a control mechanism. It utilized state variables to define the system element's operational modes and the system's environment. A utility space is established to quantify the management philosophy and the users' desires. The solution process utilizes heuristic programming, the principle of tearing, dynamic programming, and constrained continuous optimization. A methodology for solving the large-scale zero-one model is presented Dissert. Abstr.

N77-11484 Massachusetts Univ., Amherst.
SOURCES OF ORGANIC COLOR IN NATURAL WATERS Ph.D. Thesis
Bill Otto Wilen 1976 358 p
Avail: Univ. Microfilms Order No. 76-22311

The organic matter research was conducted in Western Massachusetts on a 3,000 acre watershed containing a complex of three interconnected reservoirs with a combined capacity of 46,000,000 gallons and a safe yield of 1.1 million gallons a day. Initial research efforts pinpointed the sources of organic-coloring-matter production as the wetlands in the headwaters of the watershed. Although water color production depends on climate, vegetation, land-surface form, and soils, research indicates that climate and the land-surface form of the local setting are the most important variables in water color production. A water color prediction model was developed which presented a functional tool to watershed managers for predicting water color levels at the source of production. The model's success was due to the fact that the level of water color produced is very similar for different wetland types at the source of production. Dissert. Abstr.

N77-11485*# Minnesota State Planning Agency, St. Paul.
ERTS-B APPLICATIONS TO MINNESOTA RESOURCE MANAGEMENT Progress Report, 25 Mar. - 25 Jun. 1976
Joseph E. Sizer, Principal Investigator 15 Sep. 1976 21 p ERTS
(Contract NAS5-20985)
(E77-10005; NASA-CR-148976) Avail: NTIS HC A02/MF A01 CSCL 05B

The author has identified the following significant results. The shape, pattern, and extent of surface water (e.g. lakes) can be readily mapped. Comparing detailed maps of several lakes in Itasca County with the areas classified as water by the LANDSAT data show that some lakes have changed considerably since they were mapped. Due to several droughts this year (1976), the water level in most lakes has dropped. At this time, it seems feasible that LANDSAT digital tape data estimate lake water level change, due to the 1976 drought conditions.

N77-11486*# Delaware Univ., Newark. Coll. of Marine Studies.
SPECTRAL REFLECTANCE SIGNATURES OF COASTAL POLLUTANTS Progress Report
V. Klemas, Principal Investigator and W. Philpot 18 Oct. 1976 83 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Grant NsG-1149)
(E77-10011; NASA-CR-148981) Avail: NTIS HC A05/MF A01 CSCL 13B

There are no author-identified significant results in this report.

N77-11487*# Instituto Geofisico del Peru, Lima.
APPLICATION OF REMOTE SENSING TECHNIQUES FOR THE STUDY AND EVALUATION OF NATURAL RESOURCES IN PERU Progress Report
Jose C. Pomalaya, Principal Investigator 1975 3 p Sponsored by NASA ERTS
(E77-10024; NASA-CR-149127) Avail: NTIS HC A02/MF A01 CSCL 08F

There are no author-identified significant results in this report.

N77-11488*# Science Univ. of Tokyo (Japan).
INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN

IN JAPAN Quarterly Progress Report, Jul. - Sep. 1976
Takakazu Maruyasu, Hiroaki Ochiai, Yasuhiro Sugimori, Daitaro Shoji, Kaname Takeda, Kiyoshi Tsuchiya, Iwao Nakajima, Takamasa Nakano, Shigechika Hayashi, Seiji Horikawa, Principal Investigators et al 29 Oct. 1976 18 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10025; NASA-CR-149128) Avail: NTIS HC A02/MF A01 CSCL 04B

The author has identified the following significant results. A detailed land use classification for a large urban area of Tokyo was made using MSS digital data. It was found that residential, commercial, industrial, and wooded areas and grasslands can be successfully classified. A mesoscale vortex associated with large ocean current, Kuroshio, which is a rare phenomenon, was recognized visually through the analysis of MSS data. It was found that this vortex affects the effluent patterns of rivers. Lava flowing from Sakurajima Volcano was clearly classified for three major erruptions (1779, 1914, and 1946) using MSS data.

N77-11489*# Corps of Engineers, Waltham, Mass.
THE LANDSAT SATELLITE AND FLOOD CONTROL IN NEW ENGLAND, JUNE 1976
Saul Cooper, Principal Investigator [1976] 10 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10026; NASA-CR-149129) Avail: NTIS HC A02/MF A01 CSCL 08H

There are no author-identified significant results in this report.

N77-11490*# Helsinki Univ. (Finland). Dept. of Geology.
USE OF SATELLITE PICTURES FOR DETERMINING MAJOR SHIELD FRACTURES RELEVANT FOR ORE PROSPECTING, NORTHERN FINLAND
Heikki V. Tuominen and Jussi Aarnisalo, Principal Investigators Sep. 1976 101 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10027; NASA-CR-149130) Avail: NTIS HC A06/MF A01 CSCL 08G

The author has identified the following significant results. A combined analysis of LANDSAT 1 imagery, aeromagnetic and other maps, and aerial photos has revealed a dense network of bedrock fractures in northern Finland. They form several fracturing zones, which obviously represent surficial manifestations of major fractures. The fractures follow, in general, the eight main trends of crustal shear characteristics of the Baltic Shield, but show distinct deviations from them in detail. The major fracture zones divide the bedrock into a mosaic of polygonal blocks, which in many cases coincide with the main rock units of the area and are characterized by different patterns of internal fracturing. Known mineralizations show a tendency to concentrate along the fracture zones. Optical filtering of original LANDSAT images might provide a rapid tool for the analysis of major structural trends in extensive areas such as shields or entire continents.

N77-11491*# Servicio Geologico de Bolivia, La Paz.
THE 29950 EARTH RESOURCE TECHNOLOGY SATELLITE (ERTS-A) SENSOR DATA FOR MINERAL RESOURCE SECTOR DEVELOPMENT AND REGIONAL LAND USE SURVEY, MARCH - AUGUST 1976
Carlos E. Brockmann, Principal Investigator Aug. 1976 31 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10028; NASA-CR-149131) Avail: NTIS HC A03/MF A01 CSCL 08F

There are no author-identified significant results in this report.

N77-11492*# Atomic Energy Commission, Dacca (Bangladesh).
INVESTIGATIONS USING DATA FROM LANDSAT-2 Quarterly Report, Jul. - Sep. 1976
Anwar Hossain, Principal Investigator Oct. 1976 3 p refs Sponsored by NASA ERTS
(E77-10029; NASA-CR-149132) Avail: NTIS HC A02/MF A01 CSCL 05B

The author has identified the following significant results. Preliminary land use maps of Sunamgonj, Baniachong, and Srimongal areas in the Sylhet districts were prepared. Indication of new land in the southern Patuakhali district and Hatiya Island were found, and erosion in northern Hatiya Island is also indicated.

N77-11493*# Milan Univ. (Italy).
LANDSAT 2 IMAGE STUDIES AS APPLIED TO A TEST AREA IN NORTHERN APPENNINE RANGE Progress Report
C. M. Marino, Principal Investigator and E. Zilioli [1976] 7 p Sponsored by NASA ERTS
(E77-10030; NASA-CR-149133) Avail: NTIS HC A02/MF A01 CSCL 08B

There are no author-identified significant results in this report.

N77-11494*# College for Civil Engineering, Bucharest (Romania). Lab. for Remote Sensing.
USE OF LANDSAT DATA FOR NATURAL RESOURCES INVESTIGATION IN THE LOWER BASIN OF DANUBE AND DANUBE DELTA Progress Report, Apr. - Jun. 1976
Nicolaie Oprescu, Principal Investigator Jul. 1976 20 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10032; NASA-CR-149097; DaDelta-1/1) Avail: NTIS HC A02/MF A01 CSCL 08H

There are no author-identified significant results in this report.

N77-11495*# Instituto Geografico y Catastral, Madrid (Spain).
THEMATIC MAPPING, LAND USE, GEOLOGICAL STRUCTURE AND WATER RESOURCES IN CENTRAL SPAIN Quarterly Report
Nunez DeLasCuevas, Principal Investigator 6 Sep. 1976 51 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10034; NASA-CR-149135; QR-3) Avail: NTIS HC A04/MF A01 CSCL 08F

The author has identified the following significant results. A method for a rapid updating of cartography at scale 1:200,000 was established. An annular tectonic structure was detected north of Madrid which was named Structural Halo of Guadalix, since its center is situated in the locality of Guadalix de la Sierra. This circular complex has from 30 to 40 km of radius and its influences at its most extreme edges reach Madrid.

N77-11496*# Zurich Univ. (Switzerland).
DIGITAL IMAGE PROCESSING [DIGITALE BILDVERARBEITUNG]
Klaus Seidel, Principal Investigator 1976 59 p refs In GERMAN; partly in ENGLISH Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10035; NASA-CR-149136) Avail: NTIS HC A04/MF A01 CSCL 05B

There are no author-identified significant results in this report.

N77-11497*# National Marine Fisheries Service, Bay Saint Louis, Miss.
LANDSAT MENHADEN AND THREAD HERRING RESOURCES INVESTIGATION, GULF OF MEXICO Progress Report, 1 Aug. - 31 Oct. 1976
Kenneth Savastano, Principal Investigator, Andrew J. Kemmerer, Thomas Leming, Hillman Holley, and Kenneth Faller (NASA. Johnson Space Center) Nov. 1976 37 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(NASA Order S-54114)
(E77-10036; NASA-CR-149137; SEFC-Contrib-464; MARMAP-Contrib-132; Rept-6) Avail: NTIS HC A03/MF A01 CSCL 08A

The author has identified the following significant results. The most significant achievements thus far include the successful charting of high probability fishing areas from LANDSAT MSS data and the successful simulation of an operational satellite system to provide tactical information for the commercial harvest of menhaden.

N77-11498*# Ministry of Public Works, Mexico City.
INVESTIGATION OF LONG SCOPE FOR HIGHWAY ENGINEERING PURPOSES Final Report, May - Jul. 1976
Javier Toribio Arzate, Principal Investigator Jul. 1976 13 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10037; NASA-CR-149138) Avail: NTIS HC A02/MF A01 CSCL 13B

There are no author-identified significant results in this report.

N77-11499*# Academy of Scientific Research and Technology, Cairo (Egypt).
GEOLOGICAL AND ENVIRONMENTAL RESOURCES INVESTIGATIONS IN EGYPT USING LANDSAT IMAGES Quarterly Progress Report
M. Abdel-Hady, Principal Investigator [1976] 21 p refs Sponsored by NASA ERTS
(E77-10039; NASA-CR-149140; QPR-2) Avail: NTIS HC A02/MF A01 CSCL 08G

There are no author-identified significant results in this report.

N77-11500*# Department of Scientific and Industrial Research, Christchurch (New Zealand). Physics and Engineering Lab.
DEVELOPMENT OF REMOTE SENSING TECHNOLOGY IN NEW ZEALAND, PART 1. SEISMOTECTONIC, STRUCTURAL, VOLCANOLOGIC AND GEOMORPHIC STUDY OF NEW ZEALAND, PART 2. INDIGENOUS FOREST ASSESSMENT, PART 3. MAPPING LAND USE AND ENVIRONMENTAL STUDIES IN NEW ZEALAND, PART 4. NEW ZEALAND FOREST SERVICE LANDSAT PROJECTS, PART 5. GEOGRAPHICAL APPLICATIONS IN LANDSAT MAPPING: LANDUSE MAPPING AND ENVIRONMENTAL STUDIES, PART 6 Quarterly Report
Mervyn C. Probine, Richard P. Suggate, Michael G. McGreevy, and Ian F. Stirling, Principal Investigators Sep. 1976 116 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10040; NASA-CR-149152; Rept-553; QR-3) Avail: NTIS HC A06/MF A01 CSCL 08F

There are no author-identified significant results in this report.

N77-11501*# Department of the Environment, Ottawa (Ontario).
RETRANSMISSION OF HYDROMETRIC DATA IN CANADA Quarterly Report, Jul. - Sep. 1976
R. A. Halliday, Principal Investigator and I. A. Reid Oct. 1976 11 p Sponsored by NASA ERTS
(E77-10041; NASA-CR-149153) Avail: NTIS HC A02/MF A01 CSCL 08H

The author has identified the following significant results. Results have demonstrated the suitability of satellite retransmission as a means of obtaining near real time data from remote areas in Canada. Capital costs of the equipment installed at a gaging station are reasonable, and indications are that the DCPs do not require much maintenance. The potential impact on water resources data gathering activities is considerable.

N77-11502*# Texas Univ. Health Science Center, Houston. School of Public Health.
POTENTIAL ROLE OF REMOTE SENSING IN DISASTER RELIEF MANAGEMENT
Marjorie Rush, Alfonso Holguin, and Sally Vernon [1976] 97 p refs Original contains color illustrations
(Grant NGL-44-084-003)
(NASA-CR-149102) Avail: NTIS HC A05/MF A01 CSCL 05A

Baseline or predisaster data which would be useful to decision making in the immediate postdisaster period were suggested for the six areas of public health concern along with guidelines for organizing these data. Potential sources of these data are identified. In order to fully assess the impact of a disaster on an area, information about its predisaster status must be known. Aerial photography is one way of acquiring and recording such data. Author

N77-11503*# Army Engineer District, Tulsa, Okla. Geology Section.
RED RIVER CHLORIDE REMOTE SENSING STUDY Final Report
31 Dec. 1975 44 p Original contains color illustrations
(NASA Order W-13557)
(NASA-CR-149189) Avail: NTIS HC A03/MF A01 CSCL 08H

Side looking radar, infrared thermal imagery and color photography, together with a few examples of black and white panoramic photos, are used to supplement information on the natural saline pollution problem that is hydrologically and geologically oriented. The study area was explored concurrently by ground methods and a reasonably good understanding of hydrogeological conditions has been achieved. Examples of the products acquired, their interpretation, and use techniques are included. Author

N77-11504*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT: NON-US STANDARD CATALOG, 1 - 30 JUNE 1976
30 Jun. 1976 137 p
(GSFC/LN-76/006; NASA-TM-X-74218) Avail: NTIS HC A07/MF A01 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and imput to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog included imagery covering the continental United States, Alaska, and Hawaii. The Non-U.S. Standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Sections 4 and 5 cover LANDSAT -1 and LANDSAT-2 coverage, respectively. Author

N77-11505*# Lockheed Electronics Co., Houston, Tex. Earth Observations Div.
THE TEN-ECOSYSTEM STUDY INVESTIGATION PLAN
E. P. Kan Sep. 1976 59 p refs
(Contract NAS9-12200)
(NASA-CR-151099; LEC-8667; JSC-11533) Avail: NTIS HC A04/MF A01 CSCL 02F

With the continental United States divided into ten forest and grassland ecosystems, the Ten Ecosystem Study (TES) is designed to investigate the feasibility and applicability of state-of-the-art automatic data processing remote sensing technology to inventory forest, grassland, and water resources by using Land Satellite data. The study will serve as a prelude to a possible future nationwide remote sensing application to inventory forest and rangeland renewable resources. This plan describes project design and phases, the ten ecosystem, data utilization and output, personnel organization, resource requirements, and schedules and milestones. Author

N77-11506*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT: US STANDARD CATALOG, 1 - 30 JUNE 1976
30 Jun. 1976 131 p
(NASA-TM-X-74219; GSFC/LU-76/006) Avail: NTIS HC A07/MF A01 CSCL 05B

The U.S. Standard Catalog lists U.S. imagery acquired by LANDSAT 1 and LANDSAT 2 which has been processed and input to the data files during the referenced month. Data, such as date acquired, cloud cover and image quality are given for each scene. The microfilm roll and frame on which the scene may be found is also given. Author

N77-11507*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT: US STANDARD CATALOG, 1 - 31 JULY 1976
30 Jul. 1976 113 p
(NASA-TM-X-74213; GSFC/LU-76/007) Avail: NTIS HC A06/MF A01 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The Non-U.S. Standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Sections 4 and 5 cover LANDSAT-1 and LANDSAT-2 coverage, respectively. Author

N77-11508*# National Academy of Sciences - National Research Council, Washington, D.C. Committee on Remote Sensing Programs for Earth Resources Surveys
RESOURCE AND ENVIRONMENTAL SURVEYS FROM SPACE WITH THE THEMATIC MAPPER IN THE 1980'S
1976 129 p refs
(Contract NASw-2895)
(NASA-CR-149191; NRC/CORSPERS-76/1) Avail: NTIS HC A07/MF A01 CSCL 08F

The selection of observation of vegetation is the primary optimization objective of the thematic mapper. The following are aspects of plans for the thematic mapper: (1) to include an appropriately modified first generation MSS in the thematic mapper mission; (2) to provide assured coverage for a minimum of six years to give agencies and other users an opportunity to justify the necessary commitment of resources for the transition into a completely valid operational phase; (3) to provide for global, direct data read-out, without the necessity for on-board data storage or dependence on foreign receiving stations; (4) to recognize the operational character of the thematic mapper after successful completion of its experimental evaluation; and (5) to combine future experimental packages with compatible orbits as part of the operational LANDSAT follow-on payloads. Author

N77-11509# Federal Energy Administration, Washington, D.C. Office of Regulation Development.
MANDATORY CANADIAN CRUDE OIL ALLOCATION REGULATIONS Final Environmental Impact Statement
May 1976 375 p refs
(PB-255319/6; FEA/H-76/220; FES-76/1) Avail: NTIS HC A16/MF A01 CSCL 10A

On January 30, 1976 the Federal Energy Administration (FEA) promulgated regulations to allocate diminishing amounts of Canadian crude oil deliveries during the period of 1976 through 1981, the last year in which some amount of Canadian crude would be made available. The regulations reflect FEA's action to minimize the impact of the Canadian action. GRA

N77-11510# Michigan State Univ., East Lansing. Dept. of Geology.
GRAVITY GEOPHYSICS FOR GROUNDWATER EXPLORATION IN GLACIATED AREAS
Robert Carmichael Jul. 1976 45 p refs
(Contract DI-14-31-0001-5022)
(PB-254542/4; W76-09758; OWRT-A-076-MICH(1)) Avail: NTIS HC A03/MF A01 CSCL 08H

The applicability of the gravity geophysics method in groundwater prospecting is assessed. By mapping variations in the gravity field over the ground surface, subsurface geologic structures such as buried stream valleys on the bedrock surface under glacial deposits are defined. Subsurface conditions and measurement errors that make the gravity method practical and innovative data analysis techniques are defined such as: (1) using theoretical diurnal-tide gravity variation as part of the drift correction, and (2) fitting a high degree polynomial surface to data to compensate for elevation errors reconnaissance surveys. GRA

N77-11511# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
BASIC STUDIES OF COAL PYROLYSIS AND HYDROGASIFICATION Quarterly Progress Report, 21 Feb. - 20 May 1976
T. W. Bush, J. B. Howard, W. A. Peters, and E. M. Suuberg 1976 25 p refs
(Grant NSF AER-75-13673)
(PB-254878/2; NSF/RA-760156; QPR-4) Avail: NTIS HC A02/MF A01 CSCL 07A

The low pressure batch sample reactor apparatus underwent the final modifications necessary to accomplish total product analyses. Concurrently with the development of the low pressure system, the successful modifications were incorporated into a design of the high pressure hydrogenation reactor. The analysis scheme for either reactor involves capturing products in four classes: (1) char; (2) gas; (3) condensible liquid; and (4) tar. The designs for many components of the laminar flow reactor were finalized. These components include the gas preheater, the coal particle feeder, the gas pressure and flow rate control system, and the process temperature control system. GRA

N77-11512# Geological Survey, Harrisburg, Pa. Water Resources Div.
TECHNICAL MANUAL FOR ESTIMATING LOW-FLOW FREQUENCY CHARACTERISTICS OF STREAMS IN THE SUSQUEHANNA RIVER BASIN Final Report
Jeffrey T. Armbruster Jun. 1976 72 p refs Prepared in cooperation with the Susquehanna River Basin Comm.
(PB-255455/8; USGS-WRI-76-51; USGS-WRD-WRI-76-045) Avail: NTIS HC A04/MF A01 CSCL 08H

Procedures are presented for estimating low flow frequency characteristics for streams in the Susquehanna River Basin. Streams have been divided into two types - major and minor. Multiple-regression techniques have been used to develop relations for estimating the 1-, 3-, 7-, 30-, and 183-day duration low flows at recurrence intervals of 10, 20, 50 and 100 years for annual series data and the 1-, 3-, 7-, and 30-day duration low flows, at the same recurrence intervals, for six individual months, May through October, inclusive. GRA

N77-11513# Little (Arthur D.), Inc., Cambridge, Mass.
STUDY OF THE FEASIBILITY OF FEDERAL PROCUREMENT OF FUELS PRODUCED FROM SOLID WASTES Final Report
Jul. 1975 256 p refs
(Contract EPA-68-01-2951)
(PB-255695/9; EPA-SW-123c) Avail: NTIS HC A12/MF A01 CSCL 13B

The feasibility for boilers to use solid waste as a supplementary fuel is studied. Data necessary to write guideline to aid operators of boilers in modifying their systems to use solid waste as a supplementary fuel are provided. The study examines industrial sized boilers, the modifications necessary, the solid waste preparation required, and system economics. GRA

N77-11514# Colorado State Univ., Fort Collins. Coll. of Forestry and Natural Resources.
ECOLOGICAL IMPACTS OF SNOWPACK AUGMENTATION IN THE SAN JUAN MOUNTAINS OF COLORADO Final Report
Harold W. Steinhoff and Jack D. Ives 9 Mar. 1976 508 p refs
(Contract DI-14-06-D-7052)
(PB-255012/7; CSU-FNR-7052-1) Avail: NTIS HC A22/MF A01 CSCL 04B

The evaluation of ecologic impacts due to varying snowpack in the San Juan Mountains is reported. It is based on a study of the influence of a snowfall ,which is quite variable in both space and time. Direct observation of the effects of snowpack augmentation was not possible during the 5-year life of the San Juan ecology project, but the relationships established between ecosystem components and snow conditions allow the estimation of possible effects of long term successful cloud seeding. GRA

N77-11515# Lewin and Associates, Inc., Washington, D.C.
ECONOMIC LIMITS OF OCS PRODUCTION WELLS
Apr. 1976 13 p
(Contract FEA-CO-03-50222-00)

(PB-255320/4; FEA/B-76/317) Avail: NTIS HC A02/MF A01 CSCL 08I

The costs are examined of OCS (outer continental shelf) oil production. Operating and maintenance costs and the economic life of offshore platforms are discussed. GRA

N77-11516# Resource Planning Associates, Inc., Cambridge, Mass.

IDENTIFICATION AND ANALYSIS OF MID-ATLANTIC ONSHORE OCS IMPACT

Feb. 1976 284 p refs Prepared for the Middle Atlantic Governors' Coastal Resources Council

(Contract FEA-CA-05-50078-00)

(PB-254925/1; RA-75-46C) Avail: NTIS HC A13/MF A01 CSCL 08I

Literature on onshore socioeconomic and environmental impacts related to Outer Continental Shelf oil and gas recovery is reviewed. Management decisions and policy choices for the next decade, and additional study needs are discussed. GRA

N77-11517# Hawaii Inst. of Geophysics, Honolulu.

COMPUTER PROGRAM PROJECTING FICTITIOUS LONGITUDE AND LATITUDE SYSTEMS ONTO STANDARD MERCATOR GRIDS

Peter P. K. Wong, Christopher Gregory, and David W. Handschumacher Dec. 1975 39 p ref

(Contract N00014-75-C-0209; NR Proj. 083-603)

(AD-A025076; HIG-75-19; HIG-Data-30) Avail: NTIS HC A03/MF A01 CSCL 08/2

A computer program has been written in FORTRAN language that plots fictitious latitudes and longitudes about an arbitary polar system onto standard Mercator projections. The mathematical development of this program is presented along with a complete program description and program listing. Several example plots generated by the program are included to demonstrate its option characteristics. Author (GRA)

N77-11518# Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.

APPLYING COMPUTER-DRAWN MAPS OF GEOLOGIC DATA TO ANALYSIS OF MINING PROBLEMS

Charles M. McCulloch Jun. 1976 32 p refs

(PB-255497/0; BM-RI-8151) Avail: NTIS HC A03/MF A01 CSCL 08I

The principles of using computers to draw maps and plot geologic data of mining areas are discussed. The types of maps that can be drawn by a computer are discussed using as examples two separate areas where poor roof and gas emissions caused mining problems. Such maps can be used not only to help identify problem areas, but also to predict areas where problems could occur, thus giving mine operators time to work out solutions prior to mining. The average cost of a computer-drawn map for a mine property is less than $100, including computer time and man-hours for data preparation. GRA

N77-11519# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

THE USE OF REMOTE SENSING DEVICES FOR ACQUIRING DATA FOR ENVIRONMENTAL MANAGEMENT PURPOSES. REPORT 2: APPLICATION OF PHOTOGRAPHIC REMOTE SENSORS TO AN ENVIRONMENTAL MANAGEMENT PROBLEM Technical Report, Feb. 1974 - Jan. 1975

Daniel H. Cress and Lewis E. Link, Jr. May 1976 100 p refs (DA Proj. 4A7-62720-A-896)

(AD-A025616; WES-TR-M-74-8-2) Avail: NTIS HC A05/MF A01 CSCL 14/5

This report demonstrates the application of a procedure developed for the systematic application of photographic remote sensor systems to specific environmental data acquisition problems. Of particular importance to this procedure is a quantitative approach to predicting a proper mission profile (i.e. film-filter combinations, scale, etc.) as a function of properties of the features of interest and the surrounding environment. The application of the procedure to an environmental management problem at a military facility within CONUS, Fort Carson, Colorado, is discussed. The primary emphasis of the work is on the acquisition of data relevant to measurement of the effects of maneuvering vehicles on the environment in two training areas (80 km2) on the post. The parameter selected for measurement is the length of vehicle paths per unit area, referred to as vehicular usage. An obvious application of the map is to support scheduling of training in areas of lowest vehicular usage and to identify areas subject to severe environmental damage. GRA

N77-11520# Texas Technological Univ., Lubbock. Dept. of Industrial Engineering.

PATHS OF MOVEMENT FOR SELECTED BODY SEGMENTS DURING TYPICAL PILOT TASKS Final Report

M. M. Ayoub, S. Deivanayagam, and K. W. Kennedy Mar. 1976 396 p refs

(Contract F33615-73-C-4307)

(AD-A025773; AMRL-TR-75-1) Avail: NTIS HC A17/MF A01 CSCL 05/8

The report describes the geometry of paths of motion for body segments when the hand travels between selected control locations within an aircraft cockpit. The controls selected for this study were the stick, the throttle, the overhead, the panel, the side-arm and the hatch. The control locations (start and end points of the hand travel) were selected to represent both conventional and high acceleration type aircraft cockpits. In addition three different seat back rest angles (13, 30 and 65 degrees) were employed to represent the conventional and high acceleration seat configurations. To adequately describe the movements of all body segments, the following landmarks on the body were studied using photogrammetric techniques: Nasion, Cervicale, Suprasternale, Acromion, Shoulder joint center, Elbow joint center, Wrist center, Grip center and Greater Trochanter. GRA

N77-11521*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LANDSAT: NON-US STANDARD CATALOG Monthly Report, 1-31 Jul. 1976

31 Jul. 1976 126 p

(NASA-TM-X-74214; GSFC/LN-76/007) Avail: NTIS HC A07/MF A01 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The Non-U.S. standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. The section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Author

N77-11522*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LANDSAT: NON-US STANDARD CATALOG Monthly Report, 1-31 Aug. 1976

31 Aug. 1976 116 p

(NASA-TM-X-74215; GSFC/LN-76/008) Avail: NTIS HC A06/MF A01 CSCL 05B

For abstract, see N77-11521.

N77-11523*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LANDSAT: US STANDARD CATALOG Monthly Report, 1-31 Aug. 1976

31 Aug. 1976 130 p

(NASA-TM-X-74216; GSFC/LU-76/008; NTISUB/B/138-76/008) Avail: NTIS HC A07/MF A01 CSCL 05B

For abstract, see N77-11521.

N77-11524# Bendix Research Labs., Southfield, Mich.

AS-11B-X AUTOMATED STEREOMAPPER Final Technical Report, Sep. 1971 - Dec. 1975

Gerald A. Brumm, Arliss E. Whiteside, George M. Bedross, Leonard A. Forrest, and Allan J. Hutchenreuther Apr. 1976 113 p

(Contract F30602-72-C-0042; AF Proj. 3202)

(AD-A025428; BRL-8031; RADC-TR-76-100) Avail: NTIS HC A06/MF A01 CSCL 08/2

Most stereoplotter systems currently in use were designed primarily for producing contour and profile outputs on a coordinatograph. Recently, however, there has been an increasing

need for topographic information in the form of digital gridpoint elevation data. While some existing systems can be used to extract this type of data, they cannot do it rapidly or efficiently. The AS-11B-X system is an experimental model of a new type of system intended particularly for the rapid collection of digital elevation data. The system achieves an increase in data collection rates of from 10-50 times that presently being obtained with conventional systems, at equivalent accuracy. The AS-11B-X system obtains its high data-collection rates by processing multiple lines of elevation points in parallel using digital processing. A combination of special techniques is used to simplify the digital processing and to reduce the amount of data storage required. While the AS-11B-X was built for evaluation as an experimental system, it has undergone extensive testing that has proven its performance capabilities and demonstrated that it can be used as a production system. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N77-11525 Pittsburgh Univ., Pa.
MULTI-YEAR TIME FRAME OPTIMIZATION OF POWER SYSTEMS WITH FOSSIL, NUCLEAR, HYDRO, PUMPED STORAGE AND PEAKING UNITS Ph.D. Thesis
Federico Angel Viramontes 1976 175 p
Avail: Univ. Microfilms Order No. 76-21798

An existing multi-year nuclear management program for fossil and units is expanded in order to include hydroelectric and pumped storage generating facilities. The partial forced outrages of the generating units are included. The hydroelectric plan considered has one reservoir that is fed by a river with stochastic described flow. Because of the nature of the problem, the optimization technique selected is dynamic programming. The volume of the water stored in the reservoir is the state variable and the amount of water released through the hydroelectric generator is the decision variable. The model takes into consideration the partial forced outages of the hydroelectric unit. The model is implemented with a computer code and an example is presented. For the pumped storage plant a dynamic programming model is presented that selects the optimal weekly pumping and generating hours. Dissert. Abstr.

N77-11526 Arizona Univ., Tucson.
A BASIS FOR ANALYZING PROSPECTIVE POWER GENERATION IN TERMS OF ENVIRONMENTAL MANAGEMENT AND ENERGY USE Ph.D. Thesis
John Bradley Chickering 1976 262 p
Avail: Univ. Microfilms Order No. 76-22481

The technical and forensic interrelationships of regional power capacity and requirements, energy resource use and availability, and environmental correlatives are investigated with respect to large stationary electric power generation facilities. United States policies regarding energy and environmental impact need improved coordination in order to conserve both. A standard is proposed for use as an adjunct with existing legal and technical procedures, and addressing the interrelationships of energy resource use and environmental impact to be anticipated from the addition of power plants within a control region, irrespective of power generation mode and fuel used. Consideration of interregional exchanges is included. Model parametry is developed, with reference to the distinction between Federal agency expertise in administering such matters, and the legislative and judicial functions as conditions precedent and subsequent. Dissert. Abstr.

N77-11527 Oregon State Univ., Corvallis.
PERFORMANCE AND OPTIMUM DESIGN ANALYSIS/ COMPUTATION FOR PROPELLER TYPE WIND TURBINES Ph.D. Thesis
Stel Nathan Walker 1976 231 p
Avail: Univ. Microfilms Order No. 76-23538

The analysis uses a strip theory approach that includes tip-loss and blade interference. A comparison is presented between analysis and test data. The comparison indicates that the analysis predicts wind turbine performance to an accuracy that is within experimental uncertainty. Design procedures for optimum wind turbines are shown to be different than those used for propellers. An optimum design generation approach for wind turbines is developed from a modified strip theory that includes tip-loss. The approach entails a local optimization of blade element parameters to maximize power output. Examples are presented that illustrate the optimum design generation procedure and off-design performance characteristics. The design analysis and optimum design generation approaches were programmed on a digital computer using the FORTRAN IV language. Program listings, operating instructions, and sample outputs are included. Dissert. Abstr.

N77-11528*# Transemantics, Inc., Washington, D.C.
INDUSTRIAL DEVELOPMENT OF SILICON SOLAR CELLS
Y. Salles NASA Aug. 1976 15 p refs Transl. into ENGLISH from Acta Electronica (France), v. 18, Oct. 1975 p 339-343 (Contract NASw-2792)
(NASA-TT-F-17139) Avail: NTIS HC A02/MF A01 CSCL 10A

Silicon solar cells were first developed and manufactured for space applications. Following a cost reduction due to technological progress, the use of the solar cells has greatly increased. The evolution of different technological steps in manufacturing solar cells and panels for terrestrial applications is described. The conversion efficiency of the cells in the BPX 47 A Panel is now 12.5 % (it was 9 % during the last few years). A cost analysis is carried out. Author

N77-11529*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMIZED SELECTIVE COATINGS FOR SOLAR COLLECTORS
G. McDonald and Henry B. Curtis Jun. 1967 12 p refs Presented at the Am. Electroplaters Soc., Denver, 29 Jun. 1976
(NASA-TM-X-73498; E-8896) Avail: NTIS HC A02/MF A01 CSCL 10A

The spectral reflectance properties of black nickel electroplated over stainless steel and of black copper produced by oxidation of copper sheet were measured for various plating times of black nickel and for various lengths of time of oxidation of the copper sheet, and compared to black chrome over nickel and to converted zinc. It was determined that there was an optimum time for both plating of black nickel and for the oxidation of copper black. At this time the solar selective properties show high absorptance in the solar spectrum and low emittance in the infrared. The conditions are compared for production of optimum optical properties for black nickel, black copper, black chrome, and two black zinc conversions which at the same conditions had absorptances of 0.84, 0.90, 0.95, 0.84, and 0.92, respectively, and emittances of 0.18, 0.08, 0.09, 0.10, and 0.08, respectively. Author

N77-11530*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF FLAT-PLATE COLLECTOR EFFICIENCY UNDER CONTROLLED CONDITIONS IN A SOLAR SIMULATOR
Susan M. Johnson and Frederick Simon 1976 19 p refs Presented at the Intern. Solar Energy Soc. Conf., Winnipeg, Canada, 15-20 Aug. 1976
(NASA-TM-X-73520; E-8932) Avail: NTIS HC A02/MF A01 CSCL 10A

The measured thermal efficiencies of 35 collectors tested with a solar simulator, along with the correlation equations used to generalize the data, are presented. The single correlation used is shown to apply to all the different types of collectors tested, including one with black paint and one cover, one with a selective surface coating and two covers, and an evacuated-tube collector.

The test and correlation technique is also modified by using a shield so that collectors larger than the simulator test area can also be tested. This technique was verified experimentally for a shielded collector for which the collector shielded area was 31% of the solar simulator radiation area. A table lists all the collectors tested, the collector areas, and the experimental constants used to correlate the data for each collector. Author

N77-11531*# TRW Defense and Space Systems Group, Redondo Beach Calif.
FLEXIBLE, FEP-TEFLON COVERED SOLAR CELL MODULE DEVELOPMENT Final Report
H. S. Rauschenbach and M. D. Cannady 13 Oct. 1976 158 p refs
(Contract NAS3-16742)
(NASA-CR-135109; TR-22353-6001-RU-00) Avail: NTIS HC A08/MF A01 CSCL 10A

Techniques and equipment were developed for the large scale, low-cost fabrication of lightweight, roll-up and fold-up, FEP-Teflon encapsulated solar cell modules. Modules were fabricated by interconnecting solderless single-crystal silicon solar cells and heat laminating them at approximately 300 C between layers of optically clear FEP and to a loadbearing Kapton substrate sheet. Modules were fabricated from both conventional and wraparound contact solar cells. A heat seal technique was developed for mechanically interconnecting modules into an array. The electrical interconnections for both roll-up and fold-up arrays were also developed. The use of parallel-gap resistance welding, ultrasonic bonding, and thermocompression bonding processes for attaching interconnects to solar cells were investigated. Parallel-gap welding was found to be best suited for interconnecting the solderless solar cells into modules. Details of the fabrication equipment, fabrication processes, module and interconnect designs, environmental test equipment, and test results are presented. Author

N77-11532*# General Electric Co., Wilmington, Mass.
SOLID POLYMER ELECTROLYTE (SPE) FUEL CELL TECHNOLOGY, PROGRAM REVIEW, PHASE 2
29 Apr. 1976 40 p
(Contract NAS9-14345)
(NASA-CR-150957) Avail: NTIS HC A03/MF A01 CSCL 10A

The purpose of the solid polymer electrolyte (SPE) fuel cell program is to advance the SPE fuel cell technology in four target areas. These areas are: (1) reduced fuel cell costs; (2) reduced fuel cell weight; (3) improved fuel cell efficiency; and (4) increased systems compatibility. Author

N77-11533# Atomic Energy of Canada Ltd., Ottawa (Ontario).
RESEARCH AND DEVELOPMENT FOR CANADIAN NUCLEAR POWER
J. A. L. Robertson Jan. 1976 22 p refs
(AECL-5314) Avail: ERDA Depository Libraries HC $3.50; AECL $3.00

Rapid expansion of the successful CANDU (Canada deuterium uranium) reactor system offers immediate substitution for scarce oil and gas, combined with long-term security of energy supplies. A continuing large and vigorous R and D program on nuclear power is essential to achieve these objectives. The program, described here, consists of tactical R and D in support of the current CANDU reactor system, strategic R and D to develop and demonstrate advanced CANDU systems, and exploratory R and D to put Canada in a position to exploit any fusion opportunities. Two support activities, management of radioactive wastes and techniques to safeguard nuclear materials against diversion, although integral components of the nuclear power programs, are identified separately because they are currently of special public interest. ERA

N77-11534# Oak Ridge National Lab., Tenn.
INDUSTRIAL THERMAL INSULATION: AN ASSESSMENT
R. G. Donnelly, V. J. Tennery, D. L. McElroy, T. G. Godfrey, and J. O. Kolb Mar. 1976 196 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5283) Avail: NTIS HC A09/MF A01

Industrial thermal insulation technology was assessed by obtaining input from a variety of sources including insulation manufacturers, system designers, installers, users, consultants, measurement laboratories, open literature, and in-house knowledge. The assessment identified a number of factors relevant to insulation materials and usage that could contribute significantly to improved energy conservation. ERA

N77-11535# Pennsylvania State Univ., University Park. Coal Research Section.
PROBLEMS AND SOLUTIONS IN THE USE OF COAL ANALYSES
P. H. Given and R. F. Yarzab Nov. 1975 46 p refs
(Contract E(49-18)-390)
(FE-0390-1) Avail: NTIS HC A03/MF A01

The various complex energy problems have stimulated a great resurgence of interest in processes for the conversion of coals into clean gaseous and liquid fuels. Chemical analyses are important to the development of these new processes to a much greater extent than in the well established methods of using coal. Standard procedures for performing the various necessary analyses have been available for many years. The problems arise because all coals are composed of an organic component (orginally derived from green plants) and an inorganic component (consisting of minerals such as clays and pyrite). If one wishes to know how much of each of these major components is present, the obvious thing to do is to burn away the organic matter and weigh the remaining ash. But in the process the inorganic components also change. Alternatively, it is desired to determine how much of the element carbon is present in the organic fuel. The standard method unfortunately cannot distinguish between the organic carbon and a form of inorganic carbon present in significant amounts in some coals. Various problems of interpreting and using coal analyses are reviewed. Finally, some consideration is given to the contribution modern instrumental methods may make to coal analysis. Author (ERA)

N77-11536# McDonnell Aircraft Co., St. Louis, Mo.
FEASIBILITY INVESTIGATION OF THE GIROMILL FOR GENERATION OF ELECTRICAL POWER
R. V. Brulle Nov. 1975 155 p refs Sponsored by ERDA
(COO-2617-75/1) Avail: NTIS HC A08/MF A01

The cyclogiro computer program, obtained from Prof. H. C. Larsen of the United States Air Force Institute of Technology, was modified to incorporate computation of blade loads for the normal operating and gust loading conditions. The program was also changed to allow computation of the effects of smoothing the blade rock angles in the region where they experienced large oscillations due to passing through a vortex shed by the previous blade. Using this program the various effects of rotor geometric parameters were investigated. Giromill configuration design concepts were explored. A baseline concept was adopted having an upper structural triangular tower extending through the lower support tower and supported by two main rotor bearings. Twenty-one different Giromill systems covering a power range of 120, 500 and 1500 kW were then synthesized. These were structurally analyzed and sized. An automatic electronic control concept built around existing equipment and employing state of the art techniques was developed. Preliminary cost estimates for generating electrical power from the Giromill systems were completed. Cost estimating relationships of the major items of equipment were formulated. Author (ERA)

N77-11537# Sandia Labs., Albuquerque, N.Mex.
SOLAR RADIATION AVAILABILITY TO VARIOUS COLLECTOR GEOMETRIES: A PRELIMINARY STUDY
E. C. Boes Feb. 1976 30 p refs
(Contract AT(29-1)-789)
(SAND-76-0009) Avail: NTIS HC A03/MF A01

Solar energy collectors of various designs and installation orientations are being built or used. Because most existing solar energy data consists of measurements of total radiation incident upon a horizontal surface, and because geometric conversion to radiation incident upon another surface is difficult, the amounts of solar energy available to various locations are not well known. Solar energy availabilities to various collectors for both clear and average days in each of the four seasons at Albuquerque, Blue Hill, and Omaha are reported. Unlike several similar previous studies, the amounts of solar energy given here are based directly on representative data samples consisting of simultaneous

measurements of direct-normal and total-horizontal radiation of these three sites. ERA

N77-11538# Sheldahl Co., Northfield, Minn. Advanced Products Div.

SOLAR POWER ARRAY FOR THE CONCENTRATION OF ENERGY. TASK 2: MODIFICATIONS TO A SPECULAR PHOTOMETER

D. A. Robinson Feb. 1976 6 p

(Contract E(11-1)-2699)

(COO-2699-3) Avail: NTIS HC A02/MF A01

The design, fabrication, and calibration are described which were completed for the modified specular photometer. The basic instrument is designed to examine the reflection or transmission of solar materials by measuring the amount of radiation which is reflected or transmitted by the material into a given acceptance aperture. ERA

N77-11539# Brookhaven National Lab., Upton, N.Y.

ATTIC CONCENTRATOR TYPE SOLAR ENERGY COLLECTOR

J. G. Cottingham 4 Feb. 1976 12 p

(Contract E(30-1)-16)

(BNL-50493) Avail: NTIS HC A02/MF A01

Inexpensive tested features of several solar energy collectors have been combined to produce an efficient low cost system. Reflector surfaces supported on metal reinforced corrugated paper redirect and concentrate solar radiation upon an inexpensive shallow pond type receiver formed by a simple wooden frame and a plastic liner. The attic with a greenhouse type south facing side forms a wind screen for the concentrator assembly permitting the use of these light weight structures. Component cost and performance estimates are given. ERA

N77-11540# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.

NATIONAL PROGRAM FOR SOLAR HEATING AND COOLING (RESIDENTIAL AND COMMERCIAL APPLICATIONS)

Oct. 1975 85 p refs

(ERDA-23A) Avail: NTIS HC A05/MF A01

This report is concerned primarily with the Federal portion of the National Program for Solar Heating and Cooling. It incorporates and modifies, where appropriate, previous Federal Government plans on solar heating and cooling. Topics considered in detail include: goals and objectives; major constraints to achieving rapid and widespread utilization; strategy; residential demonstrations; commercial demonstrations; research and development; collection and dissemination of information; additional policy measures required to achieve rapid and widespread utilization; and management. Appendices consist of solar heating and cooling (functional description), rationale for goals and objectives, summary of finding estimates, instructions for participation, list of comments received on ERDA-23, and participating personnel. ERA

N77-11541# Ames Lab., Iowa.

THERMOCHEMICAL WATER SPLITTING: THE REVERSE DEACON REACTION AND ALTERNATIVES

D. L. Ulrichson and Y. S. Yeh 17 Sep. 1975 11 p refs Presented at Intern. Energy Agency Meeting, Ispra, Italy, 17 Sep. 1975

(Contract W-7405-eng-82)

(IS-M-63; Conf-7509125-1) Avail: NTIS HC A02/MF A01

The reverse Deacon reaction is shown to require very high temperatures (1100 K or higher) or a catalyst to obtain satisfactory reaction rates. If a high temperature is used, the reverse reaction is likely to occur as the products are cooled. The reverse reaction could be minimized by very rapid cooling, but this would incur irreversible heat losses in addition to the heat required to drive the reaction. The work of separation and recycle is also very large for this reaction. Preliminary experimental work on the chlorination of magnesia and the hydrolysis of magnesium chloride indicates that both these reactions must be run as solid gas reactions. In addition, they must be run in such a way that diffusional limitations to the reaction rate are avoided. Successful demonstration of such a process may lead to a good alternate to the reverse Deacon reaction. ERA

N77-11542# Asphalt Inst., College Park, Md.

ASPHALT HOT-MIX EMISSION STUDY Final Report

Mar. 1975 112 p refs

(PB-250504/8; RR-75-1) Avail: NTIS HC A06/MF A01 CSCL 10B

Air pollution and employee health hazards resulting from the use of petroleum-derived asphalt in hot mixes were investigated. Most of the air contaminants found in the emissions were at extremely low concentrations and all fell well within currently applicable limits established by the Occupational Safety and Health Administration (OSHA). Analysis of gaseous substances included carbon monoxide, nitrogen dioxide, sulfur dioxide, hydrogen sulfide, carbonyl sulfide, mercaptans, ozone, aldehydes, phenols and C2 to C14 hydrocarbons. Solid particulates were also collected and found to contain only trace amounts of polynuclear aromatic hydrocarbons and metal compounds. (GRA)

N77-11543# Siam Inst. for Mathematics and Society, Philadelphia, Pa.

MATHEMATICS FOR ENERGY

Donald R. Snow (Brigham Young Univ.) 11 Jul. 1975 17 p refs

(Grant NSF MPS-75-05769)

(PB-252463/5; NSF/ERG-76-4) Avail: NTIS HC A02/MF A01 CSCL 10A

Large scale and economic considerations related to energy rather than specific technologies are emphasized, but additional mathematical problems arising in current and future technologies are suggested. Several of the papers dealt with linear programming models of large scale systems related to energy. These included economic models, policy models, energy sector models for supply and demand and environmental concerns. One of the economic models utilized variational techniques including such things as the Hamiltonian, the Euler-Lagrange differential equation, transversality and natural boundary conditions. GRA

N77-11544# Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Economics.

USER'S GUIDE TO PETROLEUM INDUSTRY SURVEY DATA TYPE

Jan Locken, Kathy Cole, and Duane Chapman 9 Jun. 1976 297 p refs

(Grant NSF AER-76-09748; NSF GI-41470)

(PB-256635/4; NSF/RA-760185; NSF/DF-76-001A) Avail: NTIS HC A13/MF A01 CSCL 10A

Data cover the following areas: general ownership, management, and financial structure of the companies; oil and natural gas well ownership and production, assignments, and exploratory and developmental wells; natural gas sales, purchases, processing, and gathering; petroleum refining in 1964-73; marketing; transportation and storage; foreign operations and their revenue, net worth, and ownership; uranium and coal; and, financial questions including security issues, auditing and law firms retained by the companies, and investment, revenues, cost and profits. GRA

N77-11545# West Virginia Univ., Morgantown. Dept. of Industrial Engineering.

THE USE OF AN INTERACTIVE ENERGY MODEL FOR TECHNOLOGY ASSESSMENT WITH SPECIAL REFERENCE TO UNDERGROUND COAL GASIFICATION

Jack Byrd, Jr. 1976 45 p refs

(Grant NSF GI-32724)

(PB-255543/1; NSF/RA-760130) Avail: NTIS HC A03/MF A01 CSCL 10A

Decision criteria are incorporated into a technology assessment model for new energy technologies using an interactive simulation model. Six steps for technology assessments are enumerated: (1) Define the assessment task; (2) describe relevant technologies; (3) describe the existing state; (4) formulate alternative objectives; (5) identify action options; and (6) conduct impact analyses. Merit and utilization of this procedure are demonstrated in conjunction with underground coal gasification research. GRA

N77-11546# Federal Energy Administration, Washington, D.C. Office of Energy Resource Development.

STRATEGIC PETROLEUM RESERVE Draft Environmental

Impact Statement
Jun. 1976 323 p
(PB-255476/4; FEA/G-76/331) Avail: NTIS HC A14/MF A01 CSCL 10A

The strategic petroleum reserve program was mandated by the energy policy and conservation act of 1975. FEA has identified three alternative storage systems for satisfying the objectives of the program. These alternatives, which consist of solution mined cavities in salt, conventional mines and above ground tankage, are discussed. Prototype worst case facilities were developed to characterize these systems and to provide a basis for determining potential program impacts and resource requirements. Author

N77-11547# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
APPLIED RESEARCH ON II-VI COMPOUND Quarterly Progress Report, 1 Jan. - 31 Mar. 1976
Richard H. Bube, Alan Fahrenbruch, E. H. Z. Taheri, Julio Aranovich, and Fredrik Buch Apr. 1976 45 p refs
(Grant NSF AER-75-1679)
(PB-254637/2; NSF/RA-760102) Avail: NTIS HC A03/MF A01 CSCL 10B

From electron beam induced current measurements a minority carrier diffusion length of 0.4 micrometers was obtained in the CdTe of the p-Cd/n-CdS film-on crystal solar cell. Primary results on a p-CdTe/n-1TO (indium-tin oxide) cell show excellent diode characteristics, a high V sub open current oc but low filter factor ff.A preliminary cell using a solution sprayed layer of CdS on crystal p-CdTe gives a solar efficiency of 5.6%. Measurements of non-ohmic Au and Ni contacts to p-CdTe indicate that the junctions are Schottky barriers 0.3 to 0.5 eV high. (GRA)

N77-11548# Ohio State Univ. Research Foundation, Columbus.
SEMICONDUCTOR-ELECTROLYTE PHOTOVOLTAIC ENERGY CONVERTER Quarterly Report, 1 Feb. - 30 Apr. 1975
W. W. Anderson and Larry B. Anderson 25 Jun. 1975 38 p refs
(Grant NSF AER-74-13292)
(PB-252837/0; OSURF-4122-1; NSF/RA/N-75-285) Avail: NTIS HC A03/MF A01 CSCL 10B

The physical processes involved in the conversion of radiant energy to electrical and/or chemical energy in a semiconductor-electrolyte cell are described. These processes are then related to the problem of solar energy conversion and the desirable characteristics of such a cell are defined and potential efficiency of the device is shown to be comparable to that of a pn junction solar cell. Photo current and differential capacitance were measured as a function of terminal potential with CdS- and GaAs-electrolyte photovoltaic cells to determine open circuit voltage, and power conversion efficiency. For both cells, the quantum efficiency was larger than unity at short wavelengths indicating that current doubling is occurring at the interface. GRA

N77-11549# Stanford Research Inst., Arlington, Va.
MEETING REPORT: ADVANCED FOSSIL FUELS SECTOR GROUP
Jun. 1976 75 p refs Held at Cincinnati, 31 Mar. 1976
(Contract EPA-68-01-1981)
(PB-255117/4; EPA-600/7-76-001) Avail: NTIS HC A04/MF A01 CSCL 21D

The general areas of concern were: (1) a review of the second sector group meeting with indications of action taken; and (2) the development of oil shale processing, in which the following areas were addressed: health effects and environmental assessment programs at EPA, ERDA, and DOD; environmental measurements and technology programs at EPA, ERDA, and DOD; and industrial point of view. GRA

N77-11550# Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Energy Systems Div.
METHODOLOGY DEVELOPMENT FOR STATISTICAL EVALUATION OF REACTOR SAFETY ANALYSES Final Report
M. Mazumdar, J. A. Marshall, and S. C. Chay Jul. 1976 142 p refs
(PB-255408/7; EPRI-NP-194) Avail: NTIS HC A07/MF A01 CSCL 18I

Present Nuclear Regulatory Commission regulations state that the performance of the Emergency Core Cooling Systems (ECCS) for nuclear power plants shall be calculated using evaluation models having certain required features. These evaluation models provide a conservative prediction of the maximum cladding temperature in the event of a design basis accident. It is the objective of EPRI's program in the statistical assessment of ECCS performance to evaluate the conservatism in the evaluation models. The anticipated result will include both an estimate of the most probable or nominal maximum cladding temperature under accident conditions, and an estimate of the probability that the cladding temperature will exceed a given maximum allowable value. This overall effort may be divided into three broad areas. These are: (1) obtaining and characterizing the required basic data; (2) development of best-estimate analytical techniques; and (3) development of methodology for the statistical propagation of input uncertainties through the analytical model. It is the third major area, methodology development for statistical propagation of uncertainties through the best-estimate code, which is the concern of the report. GRA

N77-11551# Syracuse Univ., N.Y. Coll. of Engineering.
COMMERCIAL BUILDING UNITARY HEAT PUMP SYSTEM WITH SOLAR HEATING Final Report, 31 Dec. 1974 - 31 Oct. 1975
Eugene E. Drucker, J. E. LaGraff, W. H. Card, Manus Ucar, and William S. Fleming 31 Oct. 1975 207 p refs
(Grants NSF GI-43895; ERDA-75-S-134)
(PB-255488/9; NSF/RANN/SE/GI-43895/PR-74-4; NSF/RA/N-75-310) Avail: NTIS HC A10/MF A01 CSCL 13A

An algorithmic computational program has been written for determining the overall performance of a heating and cooling system for a typical school and an office building. The system employs a series of water-to-air heat pumps connected in a closed loop, with a flat plate, water cooled solar collector for heating and a large water storage tank. The computer program includes an economic analysis of the solar assisted system on a 30 year life cycle basis, with interest rate, energy cost and escalation, and solar system cost as basic economic variables. GRA

N77-11552# Ernst and Ernst, Washington, D.C.
ENERGY-ECONOMY RELATIONSHIPS Final Report
Jun. 1976 313 p refs
(Contract DI-14-03-6101N)
(PB-255171/1) Avail: NTIS HC A14/MF A01 CSCL 05C

In order to address the relationships between energy (and electricity) use and economic development, both aggregated national data and detailed industry data were examined. The objectives were to provide a theoretical and quantitative description of the relationships between energy electricity, employment, and output for specified industry groups, focusing on electricity use in the aluminum industry because of its importance as a Pacific Northwest electricity consumer. GRA

N77-11553# Federal Energy Administration, Washington, D.C. Office of Data and Analysis.
ENERGY INFORMATION ACTIVITIES AT THE FEA
Gil Rodgers May 1976 49 p refs
(PB-253962/5; FEA/B-76/218) Avail: NTIS HC A03/MF A01 CSCL 05B

Information is given to support three primary missions of the FEA. First, extensive, accurate data are needed to implement FEA programs, particularly regulatory operations. Second, reliable energy information is needed to develop and evaluate Federal energy policy. Third, FEA has a legislative mandate to publish statistical reports and analyses, data summaries, fact sheets, and other information to ensure that decision makers and the general public are kept fully informed. This publication explains those information activities. GRA

N77-11554# National Electrical Manufacturers Association, New York.
TOTAL ENERGY MANAGEMENT: A PRACTICAL HANDBOOK ON ENERGY CONSERVATION AND MANAGEMENT

Mar. 1976 61 p refs Sponsored in part by FEA and Dept. of Commerce Prepared in cooperation with Natl. Elec. Contractors Assoc., Wash., D. C., and Enviro-Management and Research, Inc., Wash., D. C.
(PB-254683/6; FEA/D-76/325) Avail: NTIS HC A04/MF A01 CSCL 10A

A practical approach for building owners and managers is provided to implement energy conservation procedures and to use energy wisely. It allows businessmen to make knowledgeable judgments on where and how to conserve energy while maintaining optimum business activity. Total energy management (TEM) is an energy conservation approach based on the premise that to effect energy savings in buildings one must make the building's systems as efficient as possible. In this way, they will consume the smallest amount of energy to perform the functions required. By considering all elements of a building's system, one can recognize a great many areas where savings can be achieved. It provides owners and managers the flexibility required to conserve energy and cut costs while meeting the needs of the building's users at the same time. GRA

N77-11555# Minnesota Energy Agency, St. Paul.
THE CHICAGO PROJECT: EVALUATION AND TESTING OF THREE TYPES OF ENERGY AUDIT PROCESSES FOR SCHOOL BUILDINGS
Feb. 1976 280 p
(Contract FEA-CA-04-50055-00)
(PB-255321/2; FEA/D-76/318) Avail: NTIS HC A13/MF A01 CSCL 13A

Techniques for identifying and alleviating excessive and unnecessary energy use in public schools are discussed. Three methods for accomplishing these goals are analyzed: (1) a computer simulation model developed by educational facilities laboratories; (2) the mini-audit system developed by the Minnesota Energy Agency; and (3) extensive energy use audits that can be performed by qualified engineering firms. GRA

N77-11556# Washington State Univ., Pullman. Dept. of Sociology and Social Research Center.
SOCIETAL IMPLICATIONS OF ENERGY SCARCITY. SOCIAL AND TECHNOLOGICAL PRIORITIES IN STEADY STATE AND CONSTRICTING SYSTEMS Final Report
Lewis F. Carter, Louis N. Gray, and Theodore Greenstein 8 Jun. 1975 192 p refs Held at Portland, Ore., 7-8 Jun. 1975 Sponsored by NSF
(PB-253097/0; NSF/ERGSS-76-6) Avail: NTIS HC A09/MF A01 CSCL 10A

A partial listing of contents includes: projections of energy demand, supply, and pricing; technological alternatives - the case of nuclear reactors; socialization and acquisitiveness; office decentralization through telecommunications; growth politics and community environmental change; scarcity and crime; multinational corporations and national economies; the social scientist's role in energy policy; and monitoring and assessing social impacts. GRA

N77-11557# Tetra Tech, Inc., Arlington, Va.
ENERGY USE IN THE CONTRACT CONSTRUCTION INDUSTRY Final Report
18 Feb. 1975 185 p refs
(Contract DI-14-01-0001-1664)
(PB-245422/1; TETRAT-A-412-75-011-F; FEA/E1-1661) Avail: NTIS HC A09/MF A01 CSCL 10B

An analysis of energy use in the contract construction industry compiled to determine the amount of energy used and the potential impact that national energy shortages would have on the industry is reported. Analysis includes building construction, heavy construction, and special trades. The industry structure, energy use, intraindustry variations, energy supply, and substitutability and conservation of fuels are stipulated. Contractors in the following industries are analyzed: single family housing; residential building; industrial building; nonresidential construction; highway and street; bridge, tunnel, and elevated highway; waterworks, sewer, pipeline, communication line, and power line; heavy construction, swimming pool and fence; and special trades. GRA

N77-11558# Tetra Tech, Inc., Arlington, Va.
ENERGY USE IN THE CONTRACT CONSTRUCTION INDUSTRY. APPENDIX A: STUDY METHODOLOGY
18 Feb. 1975 179 p
(Contract DI-14-01-0001-1664)
(PB-245423/9; TETRAT-A-412-75-011-App-A; FEA/EI-1664-A) Avail: NTIS HC A09/MF A01 CSCL 10B

Data are presented describing the activity of the contract construction industry expressed in terms of the dollar value of construction. A prime requirement of the methodology employed was the development of a traceable relationship between the dollar value of construction activity and the type of construction, geographical area of construction, and the energy consumed during construction. The basic methodology used to estimate fuel and energy use for representative construction projects involved the following: (1) postulating representative construction projects of at least three sizes for each division of the industry; and (2) identifying energy-consuming equipment required for each project and determining fuel and energy consumption rates for each equipment type. GRA

N77-11559# Parsons (Ralph M.) Co., Washington, D.C.
ENERGY USE IN THE CONTRACT CONSTRUCTION INDUSTRY. APPENDIX B: ASSESSMENT OF CONSTRUCTION EQUIPMENT AVAILABILITY, ENERGY REQUIREMENTS, AND CONSTRUCTION INDUSTRY CAPACITY TO SUPPORT PROJECT INDEPENDENCE
18 Feb. 1975 201 p
(Contract DI-14-01-0001-1664)
(PB-245424/7; TETRAT-A-412-75-011-App-B; FEA/EI-1664-B) Avail: NTIS HC A10/MF A01 CSCL 10B

Various sources are discussed for: (1) energy and energy-producing processes, necessary construction equipment used in these processes, hours required for operating the equipment, and estimated energy consumed by the construction equipment; (2) availability of necessary construction equipment; (3) impact of equipment availability on the nation's capability to expand the output of energy-producing facilities; and (4) capability of the construction industry to support Project Independence. GRA

N77-11560# National Bureau of Standards, Washington, D.C.
ENERGY CONSERVATION THROUGH EFFECTIVE ENERGY UTILIZATION: 1973 ENGINEERING FOUNDATION CONFERENCE
Jesse C. Denton, ed. (Pennsylvania Univ., Philadelphia), Stephen Webber, and John Moriarty Jun. 1976 254 p refs Conf. held at New England Coll., Henniker, N. H., 19-24 Aug. 1973; sponsored in part by NBS, NSF, and Engineering Found., N Y.
(PB-255878/1; NBS-SP-403; LC-76-18680) Avail: NTIS HC A12/MF A01 CSCL 10A

Partial Contents: effective utilization of energy and other natural resources; national benefits of energy conservation; options for energy conservation; measures of thermal energy utilization; industrial energy analysis and forecasting; management's role in industrial thermal energy utilization; a projection of energy demand by the iron and steel industry; potential energy savings in the forming of paper; potential for energy conservation in heating, ventilating and air-conditioning equipment; factors controlling the manufacture and marketing of energy conserving products; and financial feasibility of energy conservation. GRA

N77-11561# Stanford Univ., Calif.
PROCEEDINGS OF THE WORKSHOP ON MODELING THE INTERRELATIONSHIPS BETWEEN THE ENERGY SECTOR AND THE GENERAL ECONOMY
J. Daniel Khazzoom Jul. 1976 206 p refs Conf. held at Washington, D. C., 29-30 Jan. 1976 Sponsored by Elec. Power Res. Inst.
(PB-255696/7; EPRI-SR-45) Avail: NTIS HC A10/MF A01 CSCL 10A

Modeling the interrelationships between the energy sector and the rest of the economy is reported in a state of the art discussion. Reflections on the use and abuse of energy models in policy-making and policy as a constraint on model development and use are considered. The significance of transition problems in the use of energy models for policy purposes and the implications of regulation and industry structure for policy-oriented energy models are summarized. GRA

N77-11562# National Highway Inst., Washington, D. C.
CONFERENCE REPORT: ENERGY CONSERVATION IN TRANSPORTATION AND CONSTRUCTION
H. W. Busching, D. O. Covault, R. L. Dean, and R. Lochow 10 May 1976 291 p refs Conf. held in Atlanta, 2-5 Dec. 1975 Sponsored in part by Am. Road Builder's Assoc., Washington, D.C., Clemson Univ., S. C., and Ga. Inst. of Tech., Atlanta
(PB-255857/5; FHWA-NHI-76-N001) Avail: NTIS HC A13/MF A01 CSCL 10A

The following topics are discussed: highway transportation's response to energy conservation; alternate transport modes and energy consumption; alternate freight modes; public transportation and energy conservation; rail transportation - its place in the Nation's energy conservation program; vehicle performance; optimizing the use of materials and energy in construction; options for conserving energy in transportation; transportation system design; and energy conservation related to traffic operations. GRA

N77-11563# Equitable Environmental Health, Inc., Woodbury, N.Y.
SELECTED ASPECTS OF WASTE HEAT MANAGEMENT: A STATE-OF-THE-ART STUDY Final Report
Allen Serper Jun. 1976 510 p refs
(PB-255697/5; EPRI-FP-164) Avail: NTIS HC A22/MF A01 CSCL 13B

The state-of-the-art is considered for: (1) treatment of evaporative cooling systems and offstream cooling system effluents; (2) determination of additional treatment required to utilize wastewater from sewage treatment plants as makeup for cooling systems and boilers; (3) mathematical modeling for power plant cooling systems and discharges; (4) examination of field monitoring programs; (5) present research to reduce the capital cost and penalties associated with dry cooling towers; and (6) identification of areas where future research is needed. GRA

N77-11564# Office of Radiation Programs, Las Vegas, Nev.
ENVIRONMENTAL AND SAFETY ASPECTS OF ALTERNATIVE NUCLEAR POWER TECHNOLOGIES. FUSION POWER SYSTEMS
Bruce J. Mann May 1976 56 p refs
(PB-255502/7; ORP/LV-76-7) Avail: NTIS HC A04/MF A01 CSCL 18A

An examination of environmental and safety issues associated with advanced nuclear power technologies is being conducted by the EPA Office of Radiation Programs. Part of this effort has been devoted to a review of fusion power systems. In the past several years, progress in fusion power research and development has led to the production of conceptual power plant designs for several fusion concepts. These have included both magnetic and inertial (primarily laser fusion) confinement systems. One of the more promising concepts is the Tokamak magnetic confinement scheme, and several fairly detailed power plant designs based on this concept have been produced. The Tokamak designs prepared by the Princeton and Wisconsin fusion power plant design groups were used as the basis for the present review. The present discussion includes a review of the main features of Tokamak power plants with emphasis on radiological aspects. Both inplant and environmental health physics implications of the designs are briefly reviewed. Environmental control and radioactive waste management consideration are included. GRA

N77-11565# Israel Atomic Energy Commission, Yavneh. Soreq Nuclear Research Center.
THE CONTRIBUTION OF NUCLEAR TECHNOLOGY TOWARD THE SOLUTION OF ENERGY PROBLEMS
S. Yiftah Sep. 1974 18 p ref In HEBREW Presented at Natl. Symp. on Energy, Netanya (Israel), 19 Mar. 1974 Submitted for publication
(INIS-mf-1867) MF available from INIS Section, International Atomic Energy Agency, P. O. Box 590 A-1011, Vienna, Austria

The evolution of nuclear technology in the area of power production is evaluated for the next thirty years. For the years 1974-1985, many installations of PWR, BWR, PHWR and HTGR type reactors are assumed. In the years 1985-1995, there will be installation of commercial fast breeder reactors, and in the years 1995-2005, there will be coexistence of types of terminal reactors, fast breeders and fusion reactors. ERA

N77-11566# Israel Electric Corp. Ltd., Haifa.
THE NUCLEAR POWER PLANT: PREVIEW OF ITS IMPLICATIONS REGARDING THE ELECTRICITY GRID
M. Nelken, D. Wiener, R. Waltoch, and Y. Porath Sep. 1974 29 p refs In HEBREW Presented at Natl. Symp. on Energy Netanya, Israel, 19 Mar. 1974
(INIS-mf-1868) MF available from INIS Section, International Atomic Energy Agency, P. O. Box 590 A-1011, Vienna, Austria

The power plant is scheduled for 1982 and will generate about 15 percent of the total electrical power. Some aspects of the system were analyzed: voltage drop, power loss, frequency response, and the system reliability. ERA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N77-11567 Colorado Univ., Boulder.
CATALYTIC REDUCTION OF NITRIC OXIDE WITH CARBON MONOXIDE BY RARE EARTH OXIDES AND NOBLE METAL CATALYSTS Ph.D. Thesis
Jen-Liang Wu 1976 288 p
Avail: Univ. Microfilms Order No. 76-23695

Catalytic reduction of nitric oxide with carbon monoxide, a readily available reducing agent in automobile exhaust, has been proposed. A simulated automobile exhaust was passed over the catalytic bed in an oven, and the compositions of inlet and outlet streams were analyzed by a gas chromatograph to determine the % NO conversion effected by the catalyst. The relative activity of rare earth oxides in reducing the nitric oxide in the presence of carbon monoxide was investigated and established. A few noble metal catalysts, proven for their activity in catalytic NO reduction, were tested to facilitate a qualitative comparison. Cerion dioxide (ceria) was found to be the most active catalyst among all the rare earth oxides examined. The second most active was praseodymium oxide. Dissert. Abstr.

N77-11568 Virginia Polytechnic Inst. and State Univ., Blacksburg.
AEROBIC BIOLOGICAL TREATMENT OF A COLLOIDAL WASTEWATER Ph.D. Thesis
Hraj Armen Kharajian 1976 137 p
Avail: Univ. Microfilms Order No. 76-23221

A modification of the activated sludge process known as contact stabilization was examined. Both batch and continuous flow experiments were conducted under highly controlled laboratory conditions using a wastewater containing colloidal organic material to delineate process fundamentals. From the results of the batch study, it could be concluded that not all colloidal wastes are subject to a period of adsorption onto biological floc and then released back into solution as was believed previously. Results from the continuous flow experiments indicated that the completely mixed and contact stabilization processes both have similar COD removal efficiencies when compared on a total sludge age basis. It was also found that sludge production was lower in the contact stabilization system when compared to the completely mixed system. A mathematical model was developed based on results of the continuous flow experiments. Dissert. Abstr.

N77-11569*# Mitre Corp., Bedford, Mass.
EVALUATION OF SATELLITES AND REMOTE SENSORS FOR ATMOSPHERIC POLLUTION MEASUREMENTS
J. Carmichael, R. Eldridge, E. Friedman, and E. Keitz Sep. 1976 367 p refs
(NASA Order L-88328; Contract F19628-76-C-0001)
(NASA-CR-144970; MTR-7170) Avail: NTIS HC A16/MF A01 CSCL 13B

An approach to the development of a prioritized list of scientific goals in atmospheric research is provided. The results of the analysis are used to estimate the contribution of various spacecraft/remote sensor combinations for each of several important constituents of the stratosphere. The evaluation of

the combinations includes both single-instrument and multiple-instrument payloads. Attention was turned to the physical and chemical features of the atmosphere as well as the performance capability of a number of atmospheric remote sensors. In addition, various orbit considerations were reviewed along with detailed information on stratospheric aerosols and the impact of spacecraft environment on the operation of the sensors. Author

N77-11570*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METEOROLOGICAL REGIMES FOR THE CLASSIFICATION OF AEROSPACE AIR QUALITY PREDICTIONS FOR NASA-KENNEDY SPACE CENTER
J. Briscoe Stephens and Joseph C. Sloan Washington Oct. 1976 14 p refs
(NASA-TM-X-3450; M-192) Avail: NTIS HC A02/MF A01 CSCL 14B

A method is described for developing a statistical air quality assessment for the launch of an aerospace vehicle from the Kennedy Space Center in terms of existing climatological data sets. The procedure can be refined as developing meteorological conditions are identified for use with the NASA-Marshall Space Flight Center Rocket Exhaust Effluent Diffusion (REED) description. Classical climatological regimes for the long range analysis can be narrowed as the synoptic and mesoscale structure is identified. Only broad synoptic regimes are identified at this stage of analysis. As the statistical data matrix is developed, synoptic regimes will be refined in terms of the resulting eigenvectors as applicable to aerospace air quality predictions. Author

N77-11571# Oak Ridge National Lab., Tenn.
MIUS SYSTEMS ANALYSIS: EFFECTS OF UNFAVORABLE METEOROLOGICAL CONDITIONS AND BUILDING CONFIGURATIONS ON AIR QUALITY
L. Breitstein and R. E. Grant Feb. 1976 69 p refs
(Contract W-7405-eng-26)
(ONRL/HUD/MIUS-29-Add-2) Avail: NTIS HC A04/MF A01

An analytical study was made to compare the highest ground-level concentrations of atmospheric pollutants that would result from the exhaust gases of the thermal-electric subsystems of a hypothetical reference modular integrated utility system (MIUS) and conventional utility system model. Both systems served a large complex of garden type apartments under a variety of meteorological conditions, with emphasis being given to those conditions which were most likely to induce poor air quality. The possible effects of aerodynamic downwash of exhaust gases and of building configurations on air quality within an apartment complex served by MIUS are also estimated. Calculated concentrations of pollutants are compared to the appropriate air quality standards established by the Environmental Protection Agency. ERA

N77-11572# California Univ., Livermore. Lawrence Livermore Lab.
DRAFT ENVIRONMENTAL ASSESSMENT OF APPLICATION BY ERDA FOR A SPECIAL LAND USE PERMIT FOR USE OF PUBLIC LANDS IN WYOMING FOR IN SITU COAL GASIFICATION EXPERIMENTS
W. Mead 22 Jan. 1976 42 p
(Contract W-7405-eng-48)
(UCID-17011) Avail: NTIS HC A03/MF A01

The proposed experiment represents a major element in an LLL program to explore and develop a unique method of in situ coal gasification. The new method promises to provide economic access to the enormous western coal resource, while avoiding some of the principal environmental drawbacks of conventional coal-recovery methods. The LLL approach involves the creation of a zone of permeable coal--an underground packed-bed reactor--through the use of chemical high explosives emplaced in an array of drilled holes. Oxygen and steam are supplied to the in situ reactor through an injection well, and the combustible mixture of product gases is withdrawn through suitable exhaust wells. The injected oxygen allows some of the coal to burn so as to provide process heat for the desired reactions. The withdrawn product gases would be cleaned and upgraded in a surface facility to provide high-Btu pipeline-quality gas. The proposed Hoe Creek experiment will consist of explosively fracturing and dewatering a suitable zone of Felix No. 2 coal, followed by an underground gasification procedure lasting about 2 months and involving roughly 3,000 tons of coal. The environmental effects of the proposed experiment are expected to be very small. Author (ERA)

N77-11573# Energy Research and Development Administration, Laramie, Wyo. Energy Research Center.
ENVIRONMENTAL IMPACT STUDIES RELATED TO UNDERGROUND COAL GASIFICATION
Dennis D. Fischer, R. Michael Boyd, and Leo A. Schrider Apr. 1975 15 p refs
(TID-27003) Avail: NTIS HC A02/MF A01

The proposed environmental studies are an attempt to determine those areas which may influence development of UCG technology to the commercial stage. They will be conducted in an experimental project which is small in scale and which may not be totally representative of some future commercial operation. Information will be gathered concerning areas of major concern which can be used to determine if further studies are necessary. Additionally these studies will be site specific. How applicable the results might be to a site exhibiting totally different climatological and geological characteristics is unknown. More questions will be raised than will be answered, but these studies should give indications of the magnitude of possible environmental impacts resulting from UCG which will be needed to decide the worth of UCG as a new energy recovery technology. In any event, these studies will be conducted while this possible new energy recovery technique is still in the experimental phase rather than after commercial development has started. Author (ERA)

N77-11574# Radian Corp., Austin, Tex.
TOTAL SUSPENDED PARTICULATES: REVIEW AND ANALYSIS Final Task Report
R. Murray Wells Mar. 1976 252 p refs
(Contract EPA-68-02-1319)
(PB-255858/3; RAD-TN-200-045-27; EPA-600/2-76-092) Avail: NTIS HC A12/MF A01 CSCL 13B

A review and analysis of the readily available information on total suspended particulates in the atmosphere are provided. The purpose of the review was to determine the relative contribution of primary and secondary particulate matter to the total aerosol mass suspended in the atmosphere and to identify where the available information is insufficient to determine the needs for future control technology development. GRA

N77-11575# Rensselaer Polytechnic Inst., Troy, N.Y. Center for Technology Assessment.
ELECTRIC ENERGY SUPPLY ALTERNATIVES FOR NEW YORK. PHASE 2: AN APPRAISAL OF ELECTRICAL ENERGY ALTERNATIVES AVAILABLE TO THE STATE OF NEW YORK Interim Report, 1 Sep. 1974 - 31 Aug. 1975
Martin Becker Aug. 1975 172 p refs Sponsored by New York State Energy and Development Authority
(PB-249881/4; NYSERDA-75/02) Avail: NTIS HC A08/MF A01 CSCL 06J

A mathematical model was developed to facilitate comparison of alternate strategies. On the basis of data assembled and model calculations performed, observations are presented regarding commercial nuclear and coal power generation options for the near term as they relate to health, safety, and environmental impact as well as to the traditional capital and fuel cost criteria. Longer-term benefits as may be derived from the combustion of refuse and from renewable solar/wind resources are examined. Power need projections as reduced by conservation are compared to potential growth in electric demand due to substitutions of heating fuels and accelerated application of heat pump technology. GRA

N77-11576# Health Effects Research Lab., Research Triangle Park, N. C.
REGRESSION USING HOCKEY STICK FUNCTIONS
Victor Hasselblad, John P. Creason, and William C. Nelson Jun. 1976 16 p
(PB-253576/3; EPA-600/1-76-024) Avail: NTIS HC A02/MF A01 CSCL 13B

The establishment of criteria for air pollutants requires that a threshold level be established below which no adverse effects

are observed. Since standard dose response curves. Such as the logit or probit, assume an effect at all levels, a segmented function was developed. This function has zero slope up to a point, and then increases monotonically from that point. Thus the name hockey stick function. The increasing portion need not be linear; any function that can be fitted by least squares techniques will work. A method for computing confidence intervals is also given. Since the curve can be used as a dose response curve, some comparisons are made with the more conventional probit and logit curves. In general, the fit of the hockey stick curve is as good as either the logit or probit curve, even when the data originate from a logit or probit distribution. GRA

N77-11577# Stanford Univ., Calif. Dept. of Civil Engineering.
HEAT TREATMENT OF REFUSE FOR INCREASING ANAEROBIC BIODEGRADABILITY Semiannual Progress Report, 1 Jul. - 31 Dec. 1975
James M. Gossett, Joseph B. Healy, Jr., David C. Stuckey, Lily Y. Young, and Perry L. McCarty 31 Jan. 1976 96 p refs
(Grant NSF AER-74-17940-A01)
(PB-252924/6; CE-TR-205;
NSF/RANN/SE/AER-74-17940-A01; NSF/RA/N-75-283)
Avail: NTIS HC A05/MF A01 CSCL 21D

Various heat treatment procedures are considered in converting refractory organic materials to biodegradable substances so they will be convertible to methane gas. Organic refuse materials are being subjected to temperatures from 25 to 250 C, pH from 1 to 13, and for times up to 3 hours. Biodegradability is being assessed with a Warburg respirometer. Some of the chemical added for pH control was found to be consumed during heat treatment, reducing the concentration in solution which is effective in transforming organics. Semi-continuous digestion of refuse at 35 C and at a 15 day detention time resulted in 35% reduction in volatile solids and conversion of waste to methane. GRA

N77-11578# Meteorology Research, Inc., Altadena, Calif.
ANALYSIS OF THE DATA FROM THE THREE-DIMENSIONAL GRADIENT STUDY Final Report, Jul. - Sep. 1973
T. B. Smith, S. L. Marsh, W. H. White, T. N. Jerskey, B. G. Lamb, P. A. Durbin, and J. P. Killus Jan. 1976 194 p refs
Prepared jointly with Systems Appl., Inc., San Rafael, Calif.
(PB-253936/9; MRI-75-FR-1395; ARB-R-4-051-76-49;
ART-4-250; SAI/EF75-85) Avail: NTIS HC A09/MF A01 CSCL 13B

Aged pollutants tend to accumulate aloft along the foothill areas during the late afternoon. Under stagnant wind conditions, these layers of ozone and other products of photochemical reactions may remain in the area and can contribute to high surface ozone concentrations along the foothills on the following day. Examination of the effect of aerosols on the redistribution of ultraviolet radiation in the air column indicated that light scattering can cause the photodissociation rate constants aloft to be 30 to 40 percent higher than they are at the ground. The analysis of the diffusive properties of the mixed layer showed that at any hour (of a clear day) the mixing depth in the basin is related to the friction velocity. (GRA)

N77-11579# British Steel Corp., Sheffield (England). Information Services.
AIR POLLUTION MONITORING AT THE REDCAR SITE: MEASUREMENT OF GRIT AND DUST (3D) Progress Report
B. E. Prater Apr. 1976 25 p refs
(PB-254199/3; GS/TECH/424/3/75/C) Avail: NTIS HC A02/MF A01 CSCL 14B

Results obtained from directional dust gauges deployed around the Redcar site are presented. An attempt has been made to interpret the data in terms of existing sources of airborne grit and dust with some success. The British standard deposit and directional gauges have been compared, the directional gauge appears to be more sensitive to changes in dust levels. The results from the directional gauges are influenced by the height above ground level at which the gauge is sited. (GRA)

N77-11580# Virginia Polytechnic Inst. and State Univ., Blacksburg. Water Resources Research Center.
PENETRATION AND MIXING OF HEATED DISCHARGES INTO WATERWAYS
J. A. Schetz, C. H. Lewis, B. L. Sill, J. C. Chien, and D. Markham Apr. 1976 46 p refs Repr. from Va. Water Resources Research Center Bulletin 93, Apr. 1976 41 p
(PB-253957/5; VPI-VWRRC-Bull-93; W76-08926;
OWRT-B-041-VA(7)) Avail: NTIS HC A03/MF A01 CSCL 13B

Results are presented of a series of related studies of thermal discharges into waterways and the resulting mixing zones. The first investigation involved the physical situation of a single, isolated horizontal jet discharge below the surface of a deep, moving channel. The second investigation considered the configuration of a tangential jet discharge along one bank of a shallow, moving channel. As with the first configuration, results are reported for laboratory experiments, approximate analysis and numerical solutions. Limited comparisons between the predictions of the approximate analysis and some field measurements are provided. GRA

N77-11581# TRW Systems Group, Redondo Beach, Calif.
FIELD TEST SAMPLING/ANALYTICAL STRATEGIES AND IMPLEMENTATION COST ESTIMATES: COAL GASIFICATION AND FLUE GAS DESULFURIZATION Final Report, Jun. - Dec. 1975
J. W. Hamersma and S. L. Reynolds Apr. 1976 120 p refs
(Contract EPA-68-02-1412)
(PB-254166/2; TRW-24916-6041-RU-00;
EPA-600/2-76-093-b) Avail: NTIS HC A06/MF A01 CSCL 07A

Sampling and analysis implementation costs for two energy related process technologies are given. Wet limestone scrubbing of flue gas and a Lurgi coal gasification system. Two different sampling and analytical approaches were costed which would yield the same information output. The first approach, requiring two levels of sampling and analytical effort, is called the phased sampling program. The second approach was a direct single effort to achieve the same level of information for decision making as the phased approach. In the test cases, costed from sample acquisition through analysis, the phased sampling and analytical approach was the most cost effective. (GRA)

N77-11582# Army Construction Engineering Research Lab., Champaign, Ill.
ENVIRONMENTAL IMPACT COMPUTER SYSTEM ATTRIBUTE DESCRIPTOR PACKAGE: REFERENCE DOCUMENT Final Report
Apr. 1976 799 p refs
(DA Proj. 4A1-621-A-896)
(AD-A024303; CERL-TR-E-76) Avail: NTIS HC A99/MF A01 CSCL 13/2

This report describes the objective, philosophy, and use of the Environmental Attribute Descriptor Package Reference Document to the user of the Environmental Impact Computer System (EICS). The report explains why descriptor packages and paragraphs were developed, how to use them, and how they will help the user prepare Environmental Impact Assessments and Environmental Impact Statements for their projects and programs in a more economical and efficient manner. The report contains background information about EICS, describes the three environmental attribute levels, and provides a copy of all descriptor packages and paragraphs developed to date, separated by technical specialty. GRA

N77-11583# Illinois Inst. for Environmental Quality, Chicago.
ECONOMIC IMPACT STUDY OF THE PROPOSED MOTOR VEHICLE (IN-USE) NOISE REGULATIONS Final Report
Sheldon J. Plager, Peter Loquercio, Roger W. Findley, John S. Moore, and Marvin Frankel May 1976 239 p refs
(PB-255686/8; IIEQ-76-10) Avail: NTIS HC A11/MF A01 CSCL 13B

Economic impacts expected to result from the establishment of proposed noise standards applicable to motor vehicles in use in Illinois are developed. The costs of the standards as applied to the several vehicle classes (heavy, medium, and light trucks, automobiles and motorcycles), and the impact of these costs on state and local government, and on Illinois agriculture are assessed. The potential effects on prices, employment, and industrial activity

are also considered. The anticipated benefits from noise abatement expected to be achieved by the proposed standards are reviewed. GRA

N77-11584# Environmental Monitoring and Support Lab., Las Vegas, Nev. Monitoring Systems Research and Development Div.

THE STATUS AND QUALITY OF RADIATION MEASUREMENTS OF WATER Interim Report, 1974

A. N. Jarvis, R. F. Smiecinski, and D. G. Easterly Apr. 1976 30 p

(PB-255107/5; EPA-600/4-76-017) Avail: NTIS HC A03/MF A01 CSCL 14D

Laboratory performance studies involving the analysis of radionuclides in environmental media were conducted. A summary is given of the results of the water cross-check program for 1974. Examination of these results reveals that gross beta is the most difficult (44 percent within the control limits) and tritium is the least difficult (90 percent within the control limits) for the laboratories to analyze. GRA

N77-11585# Research Corp. of New England, Wethersfield, Conn.

TECHNICAL MANUAL FOR MEASUREMENT OF FUGITIVE EMISSIONS: UPWIND/DOWNWIND SAMPLING METHOD FOR INDUSTRIAL EMISSIONS Final Task Report, Jun. 1975 - Jan. 1976

Henry J. Kolnsberg Apr. 1976 78 p

(Contract EPA-68-02-2110)

(PB-253092/1; EPA-600/2-76-089-a) Avail: NTIS HC A05/MF A01 CSCL 13B

The manual provides a guide for the implementation of the upwind/downwind sampling strategy in the measurement of fugitive emissions. Criteria for the selection of the most applicable measurement method and discussions of general information gathering and planning activities are presented. Upwind/downwind sampling strategies and equipment are described. The design of the sampling system, sampling techniques, and data reduction procedures are discussed. Manpower requirements and time estimates for typical applications of the method are presented for programs designed for overall and specific emissions measurements. GRA

N77-11586# National Enforcement Investigations Center, Denver, Colo.

CHARACTERIZATION AND EVALUATION OF WASTEWATER SOURCES UNITED STATES STEEL CORPORATION, HOMESTEAD WHEEL AND AXLE PLANT, MCKEES ROCKS, PENNSYLVANIA, AUGUST 21-28, 1975

Jan. 1976 77 p refs Prepared in cooperation with EPA, Philadelphia

(PB-255593/6; EPA-330/2-76-019) Avail: NTIS HC A05/MF A01 CSCL 13B

The McKees Rocks plant consists of the older manufacturing area containing the permitted discharges, and the newer area containing mostly dry operations. Waste waters are discharged through three outfalls: 018, 019 and 020. All three outfalls discharge to the Graham Street storm sewer which flows into the Ohio River, about 0.8 km (0.5 mi) east of the plant property. On June 12, 1975, NEIC was requested to assist Region III in investigating specific USSC discharges. A reconnaissance of the Homestead works including the wheel and axle plant was conducted on July 23, 1975. GRA

N77-11587# National Enforcement Investigations Center, Denver, Colo.

CHARACTERIZATION AND EVALUATION OF WASTEWATER SOURCES UNITED STATES STEEL CORPORATION, DUQUESNE PLANT, PITTSBURGH, PENNSYLVANIA, FEBRUARY 26 - MARCH 6, 1976

May 1976 142 p refs Prepared in cooperation with EPA, Philadelphia

(PB-255594/4; EPA-330/2-76-024) Avail: NTIS HC A07/MF A01 CSCL 13B

The Duquesne Plant is primarily an iron and steel production facility with some finishing operations. Ancillary facilities include an oxygen plant, granulated slag operation and water treatment plant. All waste waters are discharged untreated with the exception of process wastes from the blast furnaces, BOF, primary mills and bar mill. Blast furnace and BOF process waste waters are treated for solids removal by gravity thickening and vacuum filtration of sludge. Scale pits are installed for the removal of mill scale from primary and bar mill waste waters. GRA

N77-11588# Environmental Technology Assessment, Inc., Oak Brook, Ill.

THE AIR QUALITY AND ECONOMIC IMPLICATIONS OF SUPPLEMENTARY CONTROL SYSTEMS IN ILLINOIS Final Report

Jay E. Norco and Roger K. Raufer Nov. 1975 122 p refs Sponsored by the Ill. Inst. for Environ. Quality

(PB-255699/1; IIEQ-75-22) Avail: NTIS HC A06/MF A01 CSCL 13B

The Illinois Pollution Control Board completed a series of inquiry hearings into the sulfur dioxide regulations and, subsequently, asked the Illinois Institute for Environmental Quality to investigate supplementary control systems (SCS) as an air pollution control strategy. The purpose of this investigation was to assess the possible impact on Illinois of supplementary control systems as a strategy for attaining air quality standards with minimum economic impact while, at the same time, conserving low sulfur fuels and maintaining the viability of the Illinois coal mining industry. The study is directed toward using this system with electric power plants. GRA

N77-11589# Automotive Testing Labs., Inc., Aurora, Colo.

AN EVALUATION OF HIGH ALTITUDE ENGINE MODIFICATION DEVICES (ECONO-KIT)

Mar. 1976 340 p

(Contract EPA-68-02-2315)

(PB-255556/3) Avail: NTIS HC A15/MF A01 CSCL 13B

In Colorado and other high altitude areas, the motor vehicle plays a disproportionate and adverse role in atmospheric pollution due to fuel enrichment and other inherent factors associated with engine operation in these areas. As a consequence, a sizeable program is required, not only for emission reduction in elevated areas, but for fuel economy improvement as well. The report deals with the devices, which include certain parametric adjustments to help compensate for the high altitude effect on carburetion and combustion in the conventional automobile engine. GRA

N77-11590# Greenfield, Attaway and Tyler, Inc., San Rafael, Calif.

DETERMINATION AND POSSIBLE PUBLIC HEALTH IMPACT OF TRANSITION METAL SULFITE AEROSOL SPECIES

Anthony V. Colucci and Delbert J. Eatough Jul. 1976 23 p refs Sponsored by Electric Power Res. Inst. Prepared in cooperation with Brigham Young Univ., Provo, Utah

(PB-255407/9; EPRI-EC-184) Avail: NTIS HC A02/MF A01 CSCL 06E

Analytic information of sulfite, one species of particulate sulfur oxide is reported. Data suggest that adverse health effects observed in Utah through epidemiologic studies which are attributed to suspended sulfates might, if proven valid, be partially attributable to atmospheric sulfite complexes in addition to or rather than sulfate. Yet another significant implication of the proposed adverse health impact of aerosol sulfite species is in the area of pollutant abatement strategy. Available data suggest that the level of S(IV) species in particulates is controlled by the level of transition metals capable of complexing with SO3(2-) (principally Fe) and not by the ambient SO2 level. GRA

N77-11591# City Coll. of the City Univ. of New York. Dept. of Chemistry.

ELECTROCHEMICAL ANALYSIS OF SULFIDIC AND AMINE ODORANTS Final Report, 1 Jun. 1973 - 30 Nov. 1974

Jerry N. Nwankwo and Amos Turk Jun. 1976 46 p refs

(Grant EPA-R-802396)

(PB-255092/9; EPA-600/2-76-021) Avail: NTIS HC A03/MF A01 CSCL 13B

Oxidation of odorous vapors at the anode of an electrochemical cell was studied as a promising approach to achieving instrumental analysis of odors. The technique of linear potential sweep cyclic voltammetry was used to investigate the oxidizability of several

amines, sulfides, and their mixtures on platinum, gold, glassy-carbon, carbon paste, and graphite electrodes. Results for runs conducted on mixtures containing combinations of primary, secondary, and tertiary amines indicated that separate current peaks were not obtained for the various amines. Results for sulfides using a platinum electrode indicated that allyl sulfide, n-butyl sulfide and tert-butyl sulfide could be oxidized in acetonitrile solution with 0.1 M NaClO4 as supporting electrolyte. GRA

N77-11592# Cramer (H.E.) Co., Inc., Salt Lake City, Utah.
WEST VIRGINIA POWER PLANT EVALUATION
H. E. Cramer and J. F. Bowers, Jr. May 1976 104 p refs
(PB-255460/8; EPA-903/9-75-022) Avail: NTIS HC A06/MF A01 CSCL 13B

Using a Gaussian diffusion model, the calculations were made of the effects of the Mitchell and Kammer power plants on ambient air quality. The highest predicted 24 hour average SO2 level is 1219 micrograms/cubic meter. Comparisons between model calculations and measurements made by EPA's Las Vegas laboratory are shown. Excellent agreement is shown for plume rise, axial concentration, and ground level concentration. GRA

N77-11593# Massachusetts Univ., Amherst. Water Resources Research Center.
DESIGNING A RIVER BASIN SAMPLING SYSTEM Completion Report
Thomas G. Sanders, Donald Dean Adrian, and Bernard B. Berger Mar. 1976 95 p refs
(Contract DI-14-31-0001-4021)
(PB-255022/6; Pub-62; FY-76-9; W76-10131; OWRT-A-041-Mass(4)) Avail: NTIS HC A05/MF A01 CSCL 13B

The major objectives were: to develop criteria to be used for specifying the number of sampling points in a river basin and their longitudinal, lateral and vertical location; and to develop criteria which would specify the frequency of sampling for baseline concentrations and year-to-year trends. The general location of sampling stations was specified by means of a stream numbering system. This location was then further refined by considerations of upstream discharges. A time series model was used to determine trends and to investigate the efficacy of various sampling frequencies. GRA

N77-11594# National Enforcement Investigations Center, Denver, Colo.
SEDIMENT STUDIES IN BACK RIVER ESTUARY, BALTIMORE, MARYLAND
Apr. 1976 41 p refs
(PB-255584/5; EPA-330/2-76-021) Avail: NTIS HC A03/MF A01 CSCL 13B

The Back River Estuary located in Maryland is investigated. The study objectives were: determine in-situ sediment oxygen demand rates of the surficial bottom deposits; determine the general distribution and approximate depth of organic sludge deposits; compare the sediment oxygen demand of surficial to underlying sediments; determine existing nutrient concentrations of surficial and subsurface sediments; and evaluate the Maryland Water Resource Authority engineering proposals for improving the water quality of the Back River Estuary. GRA

N77-11595# National Inst. of Scientific Research, Rancho Santa Fe, Calif.
DESIGN OF POLLUTANT-ORIENTED INTEGRATED MONITORING SYSTEMS. A TEST CASE: ENVIRONMENTAL LEAD Interim Report
Dale W. Jenkins Apr. 1976 62 p refs
(Contract EPA-68-03-0443)
(PB-255103/4; EPA-600/4-76-018) Avail: NTIS HC A04/MF A01 CSCL 13B

An integrated monitoring system is a systems approach for providing the information necessary to permit efficient control of those sources of pollutants causing major threats to the population of highest risk. A workship for the design of a pollutant-oriented integrated monitoring system convened by EPA in March 1974 summarized the elements of such a systems approach and discussed those information needs yet to be satisfied by basic monitoring research. GRA

N77-11596# Southern Research Inst., Birmingham, Ala.
PARTICULATE COLLECTION EFFICIENCY MEASUREMENTS ON AN ELECTROSTATIC PRECIPITATOR INSTALLED ON A PAPER MILL RECOVERY BOILER
John P. Gooch, G. H. Marchant, Jr., and Larry G. Felix May 1976 122 p refs
(Contract EPA-68-02-2114)
(PB-255297/4; SORI-EAS-76-091; EPA-600/2-76-141) Avail: NTIS HC A06/MF A01 CSCL 13B

Fractional and overall collection efficiency measurements are reported of an electrostatic precipitator collecting salt cake from a Kraft recovery boiler. Mass median diameter of the particulate entering the collector was approximately 1.0 micrometers; minimum average collection efficiency in the 0.1-2.0 micrometer diameter range was 99.92%. Size distributions at the precipitator inlet and outlet were measured with cascade impactors and an electrical aerosol analyzer. Overall mass efficiency measurements, based on a mass train with an instack filter, ranged from 99.92 to 99.96%. Fair agreement was obtained between the total mass loadings obtained with the mass trains and the impactors. GRA

N77-11597# Southern Research Inst., Birmingham, Ala.
EVALUATION OF REXNORD GRAVEL BED FILTER Final Report, period ending 31 Jan. 1976
Joseph D. McCain Jun. 1976 53 p refs
(Contract EPA-68-02-1480)
(PB-255095/2; SORI-EAS-76-299; EPA-600/2-76-164) Avail: NTIS HC A04/MF A01 CSCL 13B

Fractional and overall mass efficiency tests are reported on a full scale Rexnord gravel bed filter system used to control particulate emissions from a cement plant clinker cooler. Total flue gas particulate mass concentrations and emission rates were determined at the inlet and outlet of the gravel bed system by conventional techniques. Inlet and outlet emission rates as function of size were determined on a mass basis using cascade impactors for sizes from about 0.5 to 5 micrometers, and on a number basis for sizes smaller than about 1 micrometer using optical and diffusional methods. GRA

N77-11598# Virginia Inst. of Marine Science, Gloucester Point.
AN ASSESSMENT OF ESTUARINE AND NEARSHORE MARINE ENVIRONMENTS Final Report
M. P. Lynch, B. L. Laird, N. B. Theberge, and J. C. Jones Mar. 1976 150 p refs Revised Sponsored by The Dept. of Interior
(PB-254853/5; VIMS-SRAMSOE-93-Rev; FWS/OBS-76/05) Avail: NTIS HC A07/MF A01 CSCL 13B

The impact of water uses and projected water demands upon the estuarine and nearshore marine environments of the United States was evaluated. It included a regional review of major estuarine and nearshore marine habitats, major problems impacting water and water resources, the management approach of the states, and Federal management initiatives, particularly Federal state interactions. Estuarine resource harvest and projections are given for commercial fisheries, sport fishing, waterfowl, other wildlife harvest, bird watching, and recreational boating. Conflict areas include domestic versus foreign fleets, commerical versus sport fishing, and subsistence versus commercial harvest activities. GRA

N77-11599# Systems Applications, Inc., San Rafael, Calif.
THEORETICAL, NUMERICAL, AND PHYSICAL TECHNIQUES FOR CHARACTERIZING POWER PLANT PLUMES
Thomas W. Tesche, Gary Z. Whitten, Mark A. Yocke, and Mel-Kao Liu Feb. 1976 204 p refs Sponsored by Electric Power Res. Inst.
(EPRI Proj. 572-2)
(PB-253099/6; EPRI-EC-144) Avail: NTIS HC A10/MF A01 CSCL 13B

The chemistry and physics of plumes from fossil fuel power plants are assessed. Recent airborne measurement programs suggest that ozone may be found in power plant plumes in concentrations exceeding background levels. The question is raised whether the observed ozone build-up is due to interferences from urban plumes, measurement difficulties, or random fluctuations in atmospheric ozone concentrations. The Electric Power Research Institute (EPRI) is presently sponsoring field measurement programs designed to determine whether ozone is formed

in plumes, and mathematical modeling studies that will point out conditions favorable to ozone production. GRA

N77-11600# New England River Basins Commission, Boston, Mass.
SELECTED PRIORITIES: 1978-82. A FIRST-YEAR EFFORT RECOMMENDING PRIORITIES FOR SELECTED FEDERAL WATER AND RELATED LAND RESOURCE PROGRAMS IN NEW ENGLAND Final Report
25 Jun. 1976 105 p refs
(PB-255890/6; NERBC-PR-1) Avail: NTIS HC A06/MF A01 CSCL 13B

Priorities for Federal investment in water and related land resource programs and projects in New England are described. Priorities are recommended for fiscal year 1978 and for fiscal year 1979 through 1982 as a group. Priorities are made for the following categories: data collection, planning studies, feasibility studies, and actions. GRA

N77-11601# Environmental Monitoring and Support Lab., Las Vegas, Nev.
AIRBORNE LIDAR RAPS STUDIES, FEBRUARY 1974
John A. Eckert, James L. McElroy, Donald H. Bundy, John L. Guagliardo, and S. H. Melfi Jun. 1976 24 p refs
(PB-255886/4; EPA-600/4-76-028) Avail: NTIS HC A02/MF A01 CSCL 13B

During February 1974, an airborne downlooking lidar system was flown in support of the regional air pollution study being conducted by the U.S. Environmental Protection Agency (EPA) in St. Louis, Missouri. The lidar system was used primarily to measure mixing layer height over the metropolitan area during the morning and evening transition periods. The flight plan consisted of south to north and west to east traverses with horizontal data resolution of 1.5 kilometers and a vertical resolution of 30 meters. Final data are presented in computer-generated, iso-scattering curves plotted for altitude versus ground-distance along the particular traverse. GRA

N77-11602# Stanford Research Inst., Menlo Park, Calif.
RESEARCH TO ANTICIPATE ENVIRONMENTAL IMPACTS OF CHANGING RESOURCE USAGE Final Report, Apr. 1975 - Apr. 1976
Kendall D. Moll, ed. Apr. 1976 254 p refs Proceedings held at Menlo Park, Calif., 27-28 Aug. 1975
(Contract EPA-68-01-2940)
(PB-256293/2; SU-SRI-3570-17; EPA-600/9-76-022) Avail: NTIS HC A12/MF A01 CSCL 13B

This compilation of papers by 14 eminent authorities from government, academia, industry, and other institutions deals with research and policy problems facing EPA from recent and prospective changes in the availability of such natural resources as energy, minerals, agricultural land, and clean air and water. Among the major themes are the complex nature of interactions among resources, environments, and social values; and the need for research into the patterns of these interactions. Other themes call for increased research emphasis on patterns of resource flow and usage, on economic and social incentives for controlling the environment, on emergent potentially critical ecological problems, on several specific applied research and technology development programs, and on environmental monitoring and assessment techniques. The papers were delivered at a 1975 symposium held at Stanford Research Institute. GRA

N77-11603# Exxon Research and Engineering Co., Linden, N.J.
INVESTIGATION AND ASSESSMENT OF LIGHT-DUTY-VEHICLE EVAPORATIVE EMISSION SOURCES AND CONTROL Final Report
P. J. Clarke Jun. 1976 105 p ref
(Contract EPA-68-03-2172)
(PB-255813/8; EPA-460/3-76-014) Avail: NTIS HC A06/MF A01 CSCL 13F

The effectiveness of current evaporative control systems (ECS) is assessed along with the feasibility of various hardware approaches which control evaporative emissions to a very low level. The performance of ECS's in current use was evaluated by using the Sealed Housing for Evaporative Determinations (SHED) procedure on twenty 1973-75 cars with representative control systems. The measured emissions ranged from 0.5 to 30.6 grams per test, and the twenty car average was 8.7 grams per test. Hardware was then developed to improve ECS performance. Six production vehicles were modified to demonstrate the feasibility of improving current systems. These modifications were successful in lowering the evaporative emissions to less than 2.0 grams per test for each of the six modified vehicles. This six car group consisted of vehicles manufactured by General Motors, Ford, Chrysler, American Motors, Volvo and Mazda; and the costs of required hardware have been estimated at $2, $2, $6, $2, $2, and $25, respectively. GRA

N77-11604# Environmental Protection Agency, Washington, D.C.
JUSTIFICATIONS OF APPROPRIATION ESTIMATES FOR COMMITTEE ON APPROPRIATIONS, FISCAL YEAR 1976
1976 322 p
(PB-256464/9) Avail: NTIS HC A14/MF A01 CSCL 13B

The Environmental Protection Agency's 1976 budget proposal provides for an increase of $47 million and is presented under eight appropriations. A summary of each area and the major changes for 1976 are given. GRA

N77-11605# Rockwell International Corp., Creve Couer, Mo. Air Monitoring Center.
REGIONAL AIR POLLUTION STUDY: QUALITY ASSURANCE AUDITS Final Report
John R. Hibar Jun. 1976 45 p
(Contract EPA-68-02-1081)
(PB-255313/9; EPA-600/4-76-032) Avail: NTIS HC A03/MF A01 CSCL 14B

Aerometric data were collected for use in developing and evaluating air quality simulation models. A quality assurance audit of instrument systems employed in the Summer 1975 RAPS Expeditionary Research Program was conducted to check the various systems for accuracy. Additionally such checks provide a basis for determining the extent to which data from different instrument systems may be integrated. This report describes the audit equipment and standards used and problems encountered. Quantitative audit results from individual instrument systems are presented. The audits included analyzers for NO, NOx, O3, SO2, CO, CH4 and ThC measurements. GRA

N77-11606# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
GUIDELINES FOR AIR QUALITY MAINTENANCE PLANNING AND ANALYSIS. VOLUME 14. DESIGNATED AIR QUALITY MAINTENANCE AREAS Final Report
Dec. 1975 195 p refs
(PB-254961/6; EPA-450/4-75-002; OAQPS-1.2-043) Avail: NTIS HC A09/MF A01 CSCL 13B

Each of the Air Quality Maintenance Areas (AQMAs) identified in the Federal Register Notices of April 29, 1975 (FR 18726), June 2, 1975 (ER 23746) and September 9, 1975 (FR 41942) is described. For each AQMA in each state, the following information is given: land area, population, geographical composition and pollutants for which the area was identified. A map of each state shows the location of intrastate and interstate AQMAs. These are also shown on a U.S. map. Some data are presented in tabular form: AQMA name and pollutants by state, AQMA name and number by state, percentage of state population and percentage of state land area in AQMAs by state, and AQMA population densities by state. GRA

N77-11607# Radian Corp., Austin, Tex.
SULFUR DIOXIDE INTERFERENCE IN THE MEASUREMENT OF AMBIENT PARTICULATE SULFATES, VOLUME 2 Final Report
F. B. Meserole, Klaus Schwitzgebel, B. F. Jones, C. M. Thompson, and F. G. Mesich Feb. 1976 207 p refs Sponsored by Electric Power Res. Inst., Palo Alto, Calif.
(PB-254427/8; EPRI-262-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 13B

Literature was searched for existing methodology pertaining to the collection and analysis of ambient levels of sulfur dioxide, sulfur trioxide, sulfuric acid and particulate sulfates. The objectives were to identify (1) the concentration ranges expected for these compounds from reported data; (2) potential analytical techniques

sufficiently sensitive to quantitatively measure ambient sulfate levels; (3) highly efficient collection devices for SO2, SO3, and sulfate particulates; (4) collection devices capable of distinguishing between particulate sulfates and sulfuric acid mist; and (5) techniques to measure the chemical composition and the crystalline phase of solid particulates collected under ambient conditions. Concentration ranges of the sulfur compounds are presented together with details relating to the sources of these values and the information collected. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N77-11608 Rice Univ., Houston, Tex.
LARGE SCALE ATMOSPHERIC ELECTRIC FIELDS: COMPARISONS WITH BALLOON DATA Ph.D. Thesis
Hsiao-hua Kuo Burke 1976 131 p
Avail: Univ. Microfilms Order No. 76-21666

Measurements of air conductivity have indicated that the conductivity of the atmosphere can be approximated as an exponentially increasing function of the altitude with the scale height of 5-6 km. Because of this property, the atmospheric electric fields produced by a variety of charge sources cannot be described by the simple Coulomb field relationship. A theoretical approach is employed to calculate the large scale weather-induced atmospheric fields at different altitudes. The Green's function method is used to obtain analytic solutions for different charge sources. This mapping technique is then extended into the lower ionosphere where the conductivity is of a tensor form. The model is used to evaluate high-altitude electric-field data from a balloon flight. Dissert. Abstr.

N77-11609 Texas Univ., Dallas.
A NEW ATMOSPHERIC DIFFUSION MODEL Ph.D. Thesis
Daniel Lily Wu 1976 92 p
Avail: Univ. Microfilms Order No. 76-23154

The following two basic assumptions are considered: diffusion described by a Gaussian plume, and diffusion coefficients measured in terms of meteorological variables through a proper generalization of the theory of the Brownian motion. In a comparison of the new model with the Pasquill-Gifford model, based on the data of Project Prairie Grass, the results favored the new model. The new model was then applied to forecast the diffusion of radioactive pollutants released from the Glen Rose nuclear power plant which is under construction at Glen Rose, Texas. Dissert. Abstr.

N77-11610 California Univ., San Diego.
STUDIES IN GRAVITATION Ph.D. Thesis
Gregory James Galloway 1976 92 p
Avail: Univ. Microfilms Order No. 76-23138

A new theorem regarding closure for anisotropic cosmological models is obtained which vastly generalizes the Friedmann closure result. The isotropy assumptions are replaced by much milder physical assumptions, and the crucial Friedmann condition, 8 pi kappa rho-3h squared > 0, is replaced (in the case of dust) by the only slightly stronger 4 pi kappa rho-3h squared > 0. An interesting generalization of a global result in differential geometry is obtained. The proof of the closure theorem follows from this purely geometric result. Dissert. Abstr.

N77-11611 Rice Univ., Houston, Tex.
TIME VARIATIONS OF HF INDUCED PLASMA WAVES Ph.D. Thesis
Robert LeRoy Showen 1976 70 p
Avail: Univ. Microfilms Order No. 76-21713

Intense plasma waves are generated by an HF pump wave in an ionospheric heating experiment. These plasma waves can be observed as enhancements to the ion and plasma lines of the incoherent backscatter echo. The enhancements can be three or four orders of magnitude more intense than the unenhanced lines, and tend to fluctuate wildly. Both the purely growing and the decay mode parametric instabilities are present. When the pump wave is turned on abruptly the enhancements develop in time in a repeatable manner. A rather remarkable feature on time scales of seconds is an overshoot in instability power. These overshoots occur frequently but not universally and last for 1 to 6 seconds. They can have a magnitude from ten to hundreds of times the average instability level. Field aligned irregularities may be the cause of the overshoots. Dissert. Abstr.

N77-11612*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GLOBAL MEASUREMENTS OF GASEOUS AND AEROSOL TRACE SPECIES IN THE UPPER TROPOSPHERE AND LOWER STRATOSPHERE FROM DAILY FLIGHTS OF 747 AIRLINERS
Porter J. Perkins 1976 17 p refs Presented at the Joint Symp. of the Am. Geophys. Union, the AIAA, and the Am. Meteorol. Soc., Miami, Fla., 10-12 Nov. 1976
(NASA-TM-X-73544; E-8945) Avail: NTIS HC A02/MF A01 CSCL 04A

Extensive measurements include ozone, carbon monoxide, water vapor, and aerosol and condensation nuclei number density. Less extensive measurements include chlorofluoromethanes, sulfates and nitrates. Certain meteorological and flight information are also recorded at the time of these measurements. World routes range in latitude from about 60 deg N near North America to about 40 deg S over Australia and 23 deg S over South America. Typical data show significant changes in ozone, carbon monoxide, and water vapor when crossing the tropopause either during changes in altitude or at cruise altitude. These gases as well as light scattering particles and condensation nuclei exhibit considerable variability along a flight route. Author

N77-11613*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE COVARIANCE OF TEMPERATURE AND OZONE DUE TO PLANETARY-WAVE FORCING
G. J. Fraser Sep. 1976 36 p refs Submitted for publication
(NASA-TM-X-71212; X-911-76-192) Avail: NTIS HC A03/MF A01 CSCL 04A

The cross-spectra of temperature and ozone mass mixing ratio at 42 km and 28 km has been determined for spring (1971) and summer (1971-2) over Christchurch, New Zealand (44 S, 172 E). The sources of data are the SCR and BUV experiments on Nimbus 4. The observed covariances are compared with a model in which the temperature and ozone perturbations are forced by an upward propagating planetary wave. The agreement between the observations and the model is reasonable. It is suggested that this cross-spectral method permits an estimate of the meridional gradient of ozone mass mixing ratio from measurements of the vertical profile of ozone mass mixing ratio at one location, supported by temperature profiles from at least two locations. Author

N77-11614*# Transemantics, Inc., Washington, D.C.
A NEW ATMOSPHERIC MODEL AND EARTH-SATELLITE MOTION
A. M. Fominov NASA Jul. 1976 25 p refs Transl. into ENGLISH from 'Novaya Model Atmosfery i Dvizheniye ISZ" Bucharest, 1975 p 509-537 Presented at the Conf. on Sci. Res. by Artificial Satellites Observations, Budapest, 21-24 Oct. 1974
(Contract NASw-2792)
(NASA-TT-F-17108) Avail: NTIS HC A02/MF A01 CSCL 04A

A model for the distribution of atmospheric density in the upper atmosphere is proposed, taking into account variations of density with latitude and time of day. The atmospheric density is presented as the sum of two expansions in terms of spherical Legendre functions. Formulas are obtained for the short-period perturbations of satellite orbital elements, and of the elements of one orbital revolution around the earth. Author

N77-11615*# Scientific Translation Service, Santa Barbara, Calif.
MORPHOSTRUCTURAL METHODS OF STUDYING THE TECTRONICS OF ENCLOSED PLATFORMS, PETROLEUM-GAS-BEARING REGIONS
I. G. Golbraykh, V. V. Zabaluyev, A. N. Lastochkin, B. R. Mirkin,

and I. V. Reynin Washington NASA Jul. 1976 63 p refs Transl. into ENGLISH of the book "Morfostrukturnyye metody izucheniya tektoniki zakrykh platformennykh neftegazonosnykh oblastey" Leningrad, Nedra, 1968 p 1-43
(Contract NASw-2791)
(NASA-TT-F-16734) Avail: NTIS HC A04/MF A01 CSCL 08G

A detailed description of three groups of methods are presented. First, these are methods that exclude the exogenic component of the process of relief formation (drawing maps of tectonic relief and morphometric maps): second, studying the total brokenness of relief, which can serve as an indicator of the intensity of the latest movements: third, the method of studying megafissuring, i.e., all possible straightened elements of relief and vegetative cover that reflect the fault dislocations. The method of the constructions, methods of processing and interpreting the results obtained are described. Author

N77-11616*# Techtran Corp., Glen Burnie, Md.
EARTH MAGNETISM, THE AURORA AND ULTRALOW-FREQUENCY RADIATION
V. M. Mishin, ed. and Ye. A. Ponomarev, ed. Washington NASA Jul. 1976 38 p refs Transl. into ENGLISH from Izv. Sibirsk. Inst. Zemnogo Magnetizma, Ionosfery i Rasprostranentya Radiovoln (Irkutsk, USSR), issue 1, 1966 p 146-170
(Contract NASw-2485)
(NASA-TT-F-16737) Avail: NTIS HC A03/MF A01 CSCL 04A

The possibility is shown of improving the analytical representation of the geometric field according to satellite data by using the example of measurements of a full vector intensity modulus measured with the help of ASE 'Kosmos-49'. Author

N77-11617*# Alabama Univ., Huntsville. School of Graduate Studies and Research.
EARTH AND OCEAN MODELING Final Technical Report, 1 Dec. 1974 - 15 Sep. 1976
Francis M. Knezovich 15 Sep. 1976 157 p refs
(Contract NAS8-31194)
(NASA-CR-150055; UAH-RR-192) Avail: NTIS HC A08/MF A01 CSCL 08E

A modular structured system of computer programs is presented utilizing earth and ocean dynamical data keyed to finitely defined parameters. The model is an assemblage of mathematical algorithms with an inherent capability of maturation with progressive improvements in observational data frequencies, accuracies and scopes. The Eom in its present state is a first-order approach to a geophysical model of the earth's dynamics.
Author

N77-11618*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WATER VAPOR IN THE LOWER STRATOSPHERE MEASURED FROM AIRCRAFT FLIGHT
Ernest Hilsenrath, Bruce Guenther, and Peter Dunn Nov. 1976 17 p refs Sponsored in part by DOT Submitted for publication
(NASA-TM-X-71220; X-912-76-239) Avail: NTIS HC A02/MF A01 CSCL 04A

Water vapor in the lower stratosphere was measured in situ by two aluminum oxide hygrometers mounted on the nose of an RB57 aircraft. Data were taken nearly continuously from January to May 1974 from an altitude of approximately 11 km to 19 km as the aircraft flew between 70 deg N and 50 deg S over the land areas in the Western Hemisphere. Pseudomeridional cross sections of water vapor and temperature are derived from the flight data and show mixing ratios predominantly between 2 and 4 micron gm/gm with an extreme range of 1 to 8 micron gm/gm. Measurement precision is estimated by comparing the simultaneously measured values from the two flight hygrometer systems. Accuracy is estimated to be about + or - 40 percent at 19 km. A height-averaged latitudinal cross section of water vapor shows symmetry of wet and dry zones. Author

N77-11619# Royal Netherlands Meteorological Inst., The Hague.
ON THE THEORY OF THE ELECTROMAGNETIC SEISMOGRAPH Ph.D. Thesis - Utrecht State Univ.
I. Csikos 1975 82 p refs
(KNMI-102-95) Avail: NTIS HC A05/MF A01; Roy. Neth. Meteorol. Inst. DFI 22

The basic question dealt with is how to choose the instrumental parameters of a seismometer-galvanometer system in order to get a desired magnification of the earth's movement. This inverse problem was treated for the coupling of the seismometer with one galvanometer as a recording element. A theory was also developed for the combination of a seismometer with two galvanometers. In this case a filter galvanometer is added to the system, in series with the recording galvanometer. The method used is based on the conversion of the classical equation of the magnification curve into a polynomial, which is possible after an elementary transformation. Applying the method of least squares, the coefficients of the polynomial development are determined so that the best approximation is obtained to a desired magnification curve. As the coefficients of the polynomials are functionally related to the instrumental parameters, it is possible to calculate the values of the parameters needed for obtaining the desired magnification curve. A method was developed to calculate the magnification function of a seismograph system from the response of the seismograph to a push. The seismic record of the push is approximated by polynomials of Jacobi. In these polynomials certain properties of the system are accounted for, such as the right conditions for t = 0, and the limiting value for large t. The conditions ensure the right analytical form of the response and a fast convergence of the approximation. Using Fourier integrals the amplitude spectrum of the response can be calculated. As the magnification characteristic is proportional to the amplitude content, the magnification characteristic of the instrument can be calculated as well in a fast and simple way. Author (ESA)

N77-11620# Air Force Geophysics Lab., Hanscom AFB, Mass.
GEOMAGNETIC EFFECTS: A RAPPORTEUR PAPER
D. F. Smart 19 Apr. 1976 15 p refs Repr. from Conf. Papers, v. 11, 1975 p 3884-3895 Presented at 14th Intern. Cosmic Ray Conf., 15 - 29 Aug. 1975
(AF Proj. 8600; AF Proj. 6813)
(AD-A023720; AFGL-TR-76-0081) Avail: NTIS HC A02/MF A01 CSCL 04/1

This paper presents a summary of the 23 scientific papers on the interaction of cosmic-rays and the geomagnetic field as presented at the 14th International Cosmic Ray Conference. These geomagnetic effects will be discussed from several different viewpoints, these viewpoints roughly ordered by the cosmic ray energies being considered. Starting at relativistic energies, we first consider the earth's geomagnetic field as a quiescent stable reference. Changing to lower energies we discuss the earth's magnetosphere as a quiescent reference in which the variations occur in a systematic manner according to time of day and season of the year. Then we consider the geomagnetic field as a perturbed reference, and finally the effects of a dynamic magnetosphere. GRA

N77-11621# Boston Univ., Mass. Dept. of Astronomy.
THE CONSTRUCTION OF STORM-TIME CORRECTIONS FOR IONOSPHERIC F-REGION PARAMETERS AND THEIR APPLICATION TO TRANS-IONOSPHERIC GROUP-PATH DELAY Annual Report, 1 Sep. 1974 - 31 Aug. 1975
Michael Mendillo Mar. 1976 66 p refs
(Contract F19628-75-C-0044; AF Proj. 4643)
(AD-A024408; SER-2-N0-60; AFGL-TR-76-0057; Scientific-1) Avail: NTIS HC A04/MF A01 CSCL 04/1

A two-part investigation of magnetic storm effect upon the mid-latitude ionosphere has been carried out using as its data the AFCRL Atlas of storm effects in the F-region parameters total electron content (TEC), peak density (N sub max) and equivalent slab thickness (tau). Part I deals with the problem of applying average storm patterns (in percent) as predictions for storm-time corrections to existing TEC, N sub max, and tau models used in various propagation systems. Part II describes an analysis performed to determine the extent of trans-ionospheric group delay enhancements at 1600 MHz associated with the so-called 'Positive ionospheric disturbances' in TEC induced by geomagnetic storms. Statistical summaries are presented which describe the magnitude, duration and local time dependence of the enhancements in group delay (delta tau), measured with

respect to predicted values which do not take magnetic activity into account. GRA

N77-11622# Meteorology International, Inc., Monterey, Calif.
TESTS AND EVALUATIONS OF CLRX, THE DIAGNOSIS OF CLEAR-COLUMN RADIANCES Final Report, 2 Jun. - 2 Dec. 1975
Manfred M. Holl Dec. 1975 109 p refs
(Contract N00228-75-C-2362)
(AD-A023908; M-215; NEPRF-TR-12-75(MII)) Avail: NTIS HC A06/MF A01 CSCL 04/1

The purpose of the present project is to carry out tests and evaluations of the CLRX capability using measured VTPR (Vertical Temperature Profile Radiometer) radiances, collected by DMSP satellites, and concurrent independent resolution of atmospheric thermal-structure variabilities, from the AMTEX space-time region. GRA

N77-11623# Naval Research Lab., Washington, D.C.
NONLINEAR EQUATORIAL SPREAD F
A. J. Scannapieco and S. L. Ossakow May 1976 14 p refs
(AD-A024440; NRL-MR-3280) Avail: NTIS HC A02/MF A01 CSCL 04/1

A numerical simulation of the nonlinear evolution of the collisional Rayleigh-Taylor instability using a set of equations appropriate for the equatorial F region ionosphere has been performed. Our results show that the irregularities produced by the instability grow on the bottomside of the F region peak, as predicted by linear theory, and then the irregularities nonlinearly bubble through to the topside, where linear theory predicts no irregularities. Fourier analysis of the irregularities shows one-dimensional power-law power spectra for both the vertical and horizontal directions. Author (GRA)

N77-11624*# Stanford Univ., Calif. Inst. for Plasma Research.
COMMENT ON 'KP DEPENDENCE ON SECTORS, BY I. B. MCDIARMID AND E. E. BUDZINSKI
Leif Svalgaard Mar. 1976 11 p refs
(Grant NGR-05-020-559; Contract N00014-76-C-0207; Grants NSF ATM-74-19007; NSF DES-75-15664)
(NASA-CR-149176; AD-A024603; SU-IPR-655) Avail: NTIS HC A02/MF A01 CSCL 04/1

A suggestion by McDiarmid and Budzinski that an annual variation of geomagnetic activity can explain a sector polarity asymmetry is shown not to be necessary. The correct explanation is that the Kp-index exhibits systematic errors that enhance the UT variation during Toward polarity and decrease the UT variation during Away polarity. GRA

N77-11625# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Soil and Pavements Lab.
TABLES FOR DETERMING ISOTROPIC AND ANISOTROPIC SHEAR STRENGTHS FROM CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS Final Report
Stanley J. Johnson and Yu-Shih Jeng Apr. 1976 34 p ref
(AD-A024025; WES-MP-S-76-2) Avail: NTIS HC A03/MF A01 CSCL 08/13

This report presents instructions and tables for determining isotropic and anisotropic shear strengths from results of consolidated, undrained triaxial compression tests. GRA

N77-11626# Air Force Geophysics Lab., Hanscom AFB, Mass.
CONDITIONAL PROBABILITIES OF THE GEOMAGNETIC INDEX A SUB P
P. M. Pazich Feb. 1976 25 p refs
(AF Proj. 7601)
(AD-A023675; AFGL-TR-76-0034; AFGL-ERP-551) Avail: NTIS HC A02/MF A01 CSCL 08/14

Data of the geomagnetic index A sub p from 1932 to 1973 were used to determine the conditional probabilities for the occurrence of certain values of that index. The range of values was divided into three categories that approximately correspond to quiet, moderate, and disturbed levels of geomagnetic activity. Conditions applied were the category level of activity on the initial and subsequent day and the portion of the solar sunspot cycle. Conditional probabilities were determined for 100 successive days after the initial day, both for the quiet and active portions of the sunspot cycle. Author (GRA)

N77-11627# Army Engineer Topographic Labs., Fort Belvoir, Va.
INFERENTIAL TECHNIQUES FOR SOIL DEPTH DETERMINATIONS. PART 1: COLEOGYNE RAMOSISSIMA TORR. (BLACK-BRUSH)
Miklos Treiber and Alan E. Krusinger Nov. 1975 25 p refs
(DA Proj. 4A1-61102-B-52)
(AD-A024355; ETL-0036) Avail: NTIS HC A02/MF A01 CSCL 08/13

Inferential techniques for soil depth determinations in a high desert environment, Lake Powell, Arizona/Utah, were investigated. The use of vegetation as 'indicator species' to facilitate determinations of soil depth and soil type was examined. Coleogyne ramosissima Torr., commonly called black-brush, has been established as a reliable indicator of the depth of soil to bedrock. Over 375 soil-depth to-bedrock measurements were performed. The soil depths to bedrock within Coleogyne ramosissima communities have a mean of 21 cm with a maximum of 100 cm; the mean of soil depths to bedrock outside Coleogyne ramosissima communities was 120 cm, with a maximum measured depth of 180 cm. GRA

N77-11628# DBA Systems, Inc., Melbourne, Fla.
THE LEAST SQUARES COLLOCATION FROM THE ADJUSTMENT POINT OF VIEW AND RELATED TOPICS
Georges Blaha Apr. 1976 210 p refs
(Contract F19628-76-C-0089; AF Proj. 3205)
(AD-A024203; SR-1; AFGL-TR-76-0073) Avail: NTIS HC A10/MF A01

The most important aspects encountered in the body of this study are summarized: The approach to the collocation model formally differs from that found in the existing literature; The existing formulas are generalized so that they can apply to nonlinear models and include the option to weight any number of parameters; Formulas are given to allow for rigorous iterative solution in conjunction with the general weighting of parameters; Expressions for some new variance-covariance matrices and all combinations of covariance sub-matrices are derived. GRA

N77-11629# United Technologies Research Center, East Hartford, Conn.
CALCULATION OF ENERGETICS OF SELECTED ATMOSPHERIC SYSTEMS. THEORETICAL STUDY OF DISSOCIATIVE-RECOMBINATION OF e + NO(+) Interim Report
H. Harvey Michels Sep. 1975 51 p refs
(Contract F19628-73-C-0300; DNA Proj. NWED-QAXHD028)
(AD-A024309; Scientific-2; AFCRL-TR-75-0509) Avail: NTIS HC A04/MF A01 CSCL 07/2

Calculations have been performed for the kinetics of the dissociative-recombination of an electron and the positive ion of nitric oxide. Electronic wavefunctions have been constructed for selected dissociating states of NO and expectation values of the electronic energy and electronic transition matrix elements have been calculated. The electronic wavefunctions for NO were analyzed to determine those states responsible for dissociative-recombination. Calculations are presented for the dissociation-recombination cross-sections as a function of electron energy and vibrational state of the molecular ion. These data are also reduced to kinetic rate constants as a function of the electron temperature and ion vibrational temperature, assuming independent Boltzmann distribution functions. GRA

N77-11630# National Bureau of Standards, Washington, D.C.
PRELIMINARY REPORT ON ELECTRON ENERGY-LOSS MEASUREMENTS FOR CCIF3, CCI2F2, AND CCI3F Final Report
D. L. Bushnell, Jr., R. H. Huebner, R. J. Celotta, and S. R. Mielczarek 1975 12 p refs Repr. from Argonne Natl. Lab Report, No. ANL-75-60, Part 1, Jun. 1975 p 7-17
(PB-255227/1) Avail: NTIS HC A02/MF A01 CSCL 04B

Currently, nation-wide research efforts are devoted to studying the possible ozone (O3) depletion in the stratosphere by the chemical action of chlorine atoms released from CCl2F2 or CCl3F upon absorption of ultraviolet radiation. Since electron-impact

data taken in the forward scattering direction can be used to derive oscillator strengths and thus to yield apparent photoabsorption cross sections, the authors have carried out such an analysis for CCl2F2, CCl3F, and CClF3. The authors obtain oscillator-strength distributions between 5 and 20 eV and compare these to available photoabsorption data. Certain photoabsorption values agree very well with this electron-impact data, but other optical studies deviate in some spectral regions by as much as a factor of 5. Also, the electron energy-loss spectrum reveals electronic transitions previously undetected by photoabsorption. GRA

N77-11631# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF OPTICALLY RELEVANT TURBULENCE PARAMETERS IN THE MARINE BOUNDARY LAYER M.S. Thesis
Michele Marie Hughes Mar. 1976 67 p refs
(AD-A025421) Avail: NTIS HC A04/MF A01 CSCL 04/1

Empirically derived expressions describing the temperature index structure parameter, C sub T squared in terms of the stability parameter z/L or the Richardson number, Ri, over land were used to analyze data of mean humidity, temperature and wind speed and temperature fluctuations obtained by shipboard measurements over open ocean conditions. In general, there was little correlation between the spectral analyzed C sub T squared values and z/L or Ri. It is recommended that a different approach be used to obtain C sub T squared estimates and that z/L or Ri be modified to account for the anomalous temperature behavior found over a marine environment. GRA

N77-11632# Texas A&M Research Foundation, College Station.
COMPILATION OF STRATOSPHERIC TRACE GAS SPECTRAL PARAMETERS Final Report, 1 Dec. 1974 - 30 Nov. 1975
Louise G. Young 15 Feb. 1976 77 p refs
(Contract F19628-75-C-0104; AF Proj. 7670)
(AD-A025490; AFCRL-TR-76-0033) Avail: NTIS HC A05/MF A01 CSCL 04/1

This report describes a data compilation of the molecular spectroscopic parameters for a number of trace gases occuring in the stratosphere. The following molecules are included in the compilation: carbon monoxide, nitrous oxide, nitric oxide, nitrogen dioxide, sulfur dioxide, ammonia, formaldehyde, and nitric acid. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N77-11633 Saint Louis Univ., Mo.
SOME EFFECTS OF THE SHEARING AND VEERING ENVIRONMENTAL FLOW ON THE INTERNAL DYNAMICS AND STRUCTURE OF A SEVERE THUNDERSTORM DURING ITS MATURE STAGE Ph.D. Thesis
Pin-Tse Chang 1975 122 p
Avail: Univ. Microfilms Order No. 76-22515

A 3-dimensional model of a severe thunderstorm is employed to study some important aspects of the effects of the veering and shearing environmental wind on the structure of a typical storm during its mature stage. This environmental wind field is analytically formulated to conform with observations deduced from documented storms. Results show that fields of horizontal divergence and vertical velocity are quite sensitive to the veering and shearing environmental wind in the potential flow region. Specifically, pronounced upward and downward motions were found on the downwind and upwind side of this region, respectively. The magnitude of these vertical velocities increases with increasing vertical wind shears and is found to be closely related to pressure gradients. These findings are in good qualitative agreement with observational evidences available in the literature for a typical supercell severe thunderstorm. Dissert. Abstr.

N77-11634 Missouri Univ., Columbia.
ESTIMATING PROBABILITY OF MULTIPLE OCCURRENCE OF ANNUAL DAILY MAXIMUM RAINFALL Ph.D. Thesis
Moersidi Soepawidjaja 1975 143 p
Avail: Univ. Microfilms Order No. 76-21978

By plotting the cumulative distributions on extreme probability paper and through the use of Kolmogorov-Smirnov test statistics, it was shown that the annual daily maximum rainfall from an area like Central Illinois fits the Fisher-Tippet type I distribution. A technique for simulation of 100 location parameters, and 100 scale parameters, based on the parameters estimated from 71 years of annual daily maximum rainfall from Springfield, Illinois, was demonstrated. The aerial decay of the correlation coefficients in Central Illinois was studied by the use of 12 years data from 49 stations in the East Central Illinois Network. From these correlation coefficients it was possible to compute the parameter m required in the bivariate extremal distribution. Using the computed m values between stations, the joint probability of annual daily maximum rainfall exceeding the design criteria at each of the two locations was computed. Also the computation of conditional probability that one station's rainfall exceeds the design criteria given that the other station's rainfall exceeded its design criteria was also demonstrated. Dissert. Abstr.

N77-11635*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INITIATION OF NON-TROPICAL THUNDERSTORMS BY SOLAR ACTIVITY
John R. Herman (Radio Sci. Co., Lowell, Mass.) and Richard A. Goldberg Nov. 1976 43 p refs Submitted for publication
(NASA-TM-X-71222; X-912-76-243) Avail: NTIS HC A03/MF A01 CSCL 04B

Correlative evidence accumulating since 1926 suggests that there must be some physical coupling mechanism between solar activity and thunderstorm occurrence in middle to high lattitudes. Such a link may be provided by alteration of atmospheric electric parameters through the combined influence of high-energy solar protons and decreased cosmic ray intensities, both of which are associated with active solar events. The protons produce excess ionization near and above 20km, while the Forbush decreases a lowered conductivity and enhanced fair-weather atmospheric electric field below that altitude. Consequent effects ultimately lead to a charge distribution similar to that found in thunderclouds, and then other cloud physics processes take over to generate the intense electric fields required for lightning discharge. Author

N77-11636# Office of Radiation Programs, Washington, D.C.
RADIOLOGICAL QUALITY OF THE ENVIRONMENT
May 1976 260 p refs
(PB-254615/8; EPA-520/1-76-010) Avail: NTIS HC A12/MF A01 CSCL 06R

Radiation data were compiled on the following radiation source categories: ambient environmental radiation, technologically enhanced radiation, fallout, uranium fuel cycle, Federal facilities, medical, occupational, and industrial radiation, nonionizing radiation, and other miscellaneous sources. From the available data, it was found that the largest source of ionizing radiation dose to the population was 10 million person-rem from ambient ionizing radiation. The second largest dose was 3 million person-rem from use of radio-pharmaceuticals. About 3 million person-rem were also attributed to technologically enhanced natural radiation. GRA

N77-11637# Naval Postgraduate School, Monterey, Calif.
SAN JOAQUIN VALLEY FOG: ATTEMPTS AT ELECTRICAL DISSIPATION Final Report, Jul. 1974 - Jan. 1975
E. E. Schacher and C. W. Fairall 3 Mar. 1976 39 p refs
(AD-A023715; NPS-61SqFi76031) Avail: NTIS HC A03/MF A01 CSCL 04/2

The report summarizes the results of a two night field operation in the San Joaquin Valley of California. The purpose of this operation was to test the feasibility of using a corona discharge mechanism to dissipate warm fog. Heavy fog was encountered on two nights and during both fogs the authors monitored visibility and droplet size distribution while injecting electrical charges into the atmosphere with a 90kVolt discharge. No effects which could be attributed to modification of the fog by the corona discharge were detected. GRA

N77-11638# National Weather Service, Silver Spring, Md. Techniques Development Lab.

ASSIMILATION OF SURFACE, UPPER AIR, AND GRID-POINT DATA IN THE OBJECTIVE ANALYSIS PROCEDURE FOR A THREE-DIMENSIONAL TRAJECTORY MODEL
Ronald M. Reap Feb. 1976 22 p refs
(PB-256082/9; NOAA-TM-NWS-TDL-59; NOAA-76040903) Avail: NTIS HC A02/MF A01 CSCL 04B

The objective analysis procedure for the Techniques Development Laboratory (TDL) three-dimensional trajectory model was modified to include surface land and ship reports and initialized grid-point values from the National Meteorological Center (NMC) six-layer primitive equation (PE) model. In the new analysis procedure, upper air and PE data are assigned relative weights by means of a unique function which measures the asymmetry of the radiosonde station distribution at the initial position for each trajectory. As a result, weights applied to the upper air data are diminished with increasing station asymmetry. Conversely, weights assigned to the PE data are increased. The lapse-rate and decision-tree methods are used to assimilate surface data into the analysis procedure. A total of 25 test forecasts were made to evaluate the effect of the new analysis procedure on subsequent model forecasts. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

No abstracts in this category.

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N77-11639# Institut Franco-Allemand de Recherches, St. Louis (France).
INFLUENCE OF THE PEAK PRESSURE AND DURATION OF IMPULSE NOISE (GUN FIRE) ON THE HEARING OF THE GUINEA PIG [INFLUENCE DE LA PRESSION DE CRETE ET DE LA DUREE D'UN BRUIT IMPULSIF (BRUIT D'ARME) SUR L'APPAREIL AUDITIF DU COBAYE]
A. Dancer, R. Franke, G. Baillet, P. Vassout, and F. Devriere 27 Mar. 1975 35 p refs In FRENCH
(Contract DRME-74/024)
(ISL-R-109/75) Avail: NTIS HC A03/MF A01

The influence of peak pressure and the duration of impulse noise (gunfire type) was investigated in guinea pigs. The experimental setup used is described. Results from audiometric techniques based on the Preyer reflex and on the recording of cochlea potentials have evidenced the following factors: the evolution of the auditory sensitivity recuperation is of the 10 log t form; the importance of auditory fatigue seems related to the noise peak pressure according to 40 log delta p; and the auditory loss increases according to 20 log delta p. The increase of noise duration has no effect on auditory losses. ESA

N77-11640# Institut Franco-Allemand de Recherches, St. Louis (France).
INFLUENCE OF A PRECURSOR NOISE ON THE GLOBAL ACTION POTENTIAL CONSECUTIVE TO AN IMPULSE NOISE IN THE GUINEA PIG [INFLUENCE D'UN BRUIT PRECURSEUR SUR LE POTENTIEL D'ACTION GLOBAL CONSECUTIF A UN BRUIT IMPULSIF CHEZ LE COBAYE]
R. Franke and A. Dancer 22 Apr. 1975 26 p refs In FRENCH
(ISL-R-115/75) Avail: NTIS HC A03/MF A01

The inhibitive effect of a precursor noise in Guinea pigs was investigated studying the global action cochlean potential in order to reduce the stress (startle) provoked by the impulse noise. Experimental results show that for a given impulse noise (0.5 mbar overpressure, 2 ms duration) a precursor noise consisting of a click identical to the impulse noise, but of reduced amplitude, provokes a 33% weakening of the global action potential. In addition, a precursor noise consisting of a gust of white noise with maximum pressure (100 dB) at impulse noise incidence provokes a 70% weakening of the global action potential. The latter effect can be strengthened by a masking effect. ESA

N77-11641# Institut Franco-Allemand de Recherches, St. Louis (France).
STUDY OF METABOLIC RESPONSE VARIATION TO AN ACOUSTIC AGGRESSION [ETUDE DE LA VARIATION DE LA REPONSE METABOLIQUE A UNE AGRESSION D'ORIGINE ACOUSTIQUE]
P. Vassout and F. Devriere 29 May 1975 34 p refs In FRENCH
(ISL-R-120/75) Avail: NTIS HC A03/MF A01

The metabolic response of rats to an acoustic variation was investigated using a noise generator simulating sonic boom waves of N profiles. The operational conditions and experimental setup are presented. Experimental results including the dosage of blood plasma potassium, and glucose, as well as the dosage of catecholamines in rat urine after exposure to N acoustic waves, are discussed. A relation was found between the recovery time to return to base metabolism level and the peak pressure. In addition, isoeffect curves displaying peak pressure and exposure time versus the excretion of urine catecholamine were established. ESA

N77-11642# North Carolina Univ., Chapel Hill. Dept. of Bacteriology.
VIRION AGGREGATION AND DISINFECTION OF WATER VIRUSES BY BROMINE Final Report, Apr. 1974 - May 1975
D. Gordon Sharp May 1976 45 p refs
(Contract EPA-R-802946)
(PB-253087/1; EPA-600/2-76-163) Avail: NTIS HC A03/MF A01 CSCL 06M

Direct evidence is provided for the kind and degree of aggregation that was present among the virions that were treated with bromine as well as the PFU titers of the starters and the survivors. A dynamic system, in which disinfectant exposure time intervals as low as 0.5 seconds was developed. Polio and reovirus preparations, containing essentially all single particles, as indicated by electron microscopy, were tested in this system. The results indicated that reovirus single particle suspensions were 30 times as sensitive to bromine as poliovirus single particle suspensions, both showing essentially first order reaction kinetics with disinfection rates of 3 log base 10 per second and 6 log base 10 units per minute, respectively. GRA

N77-11643# Naval Research Lab., Washington, D.C. Marine Biology and Biochemistry Branch.
AN EVALUATION OF A FUEL-SOLUBLE ORGANOBORON BIOCIDE FOR CONTROL OF SULFATE-REDUCING BACTERIA IN SHIPBOARD FUEL TANKS Interim Report
Dorothea E. Klemme and Rex A. Neihof Apr. 1976 13 p refs
(NRL Proj. G04-01A; SR0240201)
(AD-A024017; NRL-MR-3259) Avail: NTIS HC A02/MF A01 CSCL 21/4

A biocide composed of a mixture of two dioxaborinane derivatives has been evaluated in test-tube assays and in large-scale test systems simulating conditions in shipboard, seawater-displacement fuel tanks. A concentration of approximately 20,000 ppm in the water phase was required to control sulfate-reducing bacteria of marine origin in a mixed population of microorganisms. It is not likely that this concentration can be attained in the relatively large volumes of water present in water-displacement fuel tanks by partitioning from a feasible concentration in the fuel phase. A preferable alternative for controlling microorganisms in water-displacement fuel tanks is the addition directly to the water phase of one of several previously evaluated water-soluble, fuel-insoluble biocides known to be effective at concentrations of 50 to 100 ppm. Author (GRA)

N77-11644# Advisory Group for Aerospace Research and Development, Paris (France).
THE PATHOPHYSIOLOGY OF HIGH SUSTAINED +G SUB

z ACCELERATION, LIMITATION TO AIR COMBAT MANOEUVERING AND THE USE OF CENTRIFUGES IN PERFORMANCE TRAINING

Neville P. Clarke, ed. (Texas A and M Univ., College Station) and Sidney D. Leverett, Jr., ed. (School of Aerospace Med.) Oct. 1976 77 p refs Papers presented at the Aerospace Med. Panel Specialists' Meeting, Copenhagen, 5-9 Apr. 1976 (AGARD-CP-189) Avail: NTIS HC A05/MF A01

The risk of significant cardiovascular change to a tactical fighter pilot from exposure to aerial combat accelerations such as those postulated for new high performance aircraft is investigated. Miniature swine were used as animal models to study the effects of high sustained acceleration. The seatback angle was assessed in relation to the psycho-physiological and physio-chemical changes in the human body. The utilization of the human centrifuge for training military pilots for air combat maneuvering +Gz stress is covered including the stress response and stress tolerance during the maneuvers. Centrifuge training improves the pilot's ability to effectively perform in the high G environment. For individual titles, see N77-11645 through N77-11653.

N77-11645# School of Aerospace Medicine, Brooks AFB, Tex.
CHANGES IN CLINICAL CARDIOLOGIC MEASUREMENTS ASSOCIATED WITH HIGH +G SUB z STRESS c52

Kent K. Gillingham and Phelps P. Crump *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 9 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

Because of reports of subendocardial hemorrhage and myofibrillar degeneration in animals exposed to sustained high G loads, questions have been raised regarding the safety of exposing pilots and human subjects to the similar G-stress levels likely to be encountered in the new high performance fighter aircraft. Noninvasive clinical cardiologic data, including ECGs, vectorcardiograms, systolic time intervals, and maximal treadmill stress tests, were obtained from two groups of subjects before and at several times after exposure to high-G stress. The group exposed to the greater G stress developed moderate cutaneous petechiasis and had other minor physical findings after the G stress, but showed few significant changes in cardiologic data: serum total CPK and LDH levels rose, and preejection period shortened at 48 h poststress. The group exposed to the lesser G stress had no symptoms following the G stress, but the vectorcardiograms revealed transient T-loop angle changes, and preejection period measured at one week poststress was significantly decreased. Because the serum enzyme changes were noncardiac in origin, and because the few other changes were not in a direction indicative of cardiac damage, the G stresses imposed were not significantly injurious. Author

N77-11646# School of Aerospace Medicine, Brooks AFB, Tex.
VENTRICULAR PATHOLOGY IN SWINE AT HIGH SUSTAINED +G SUB z

William F. MacKenzie and Russell R. Burton *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 3 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

Study of miniature swine has shown two distinct types of cardiac pathology as the result of exposure to HSGz. Grossly visible endocardial hemorrhage of varying degrees of severity occur consistently. In severe cases damage to Purkinje fibers is adequate to explain some of the ECG changes that have been found. A stress myocardiopathy is also found characterized by randomly distributed single or grouped, degenerate and dead muscle fibers surrounded by normal appearing fibers. Electron microscopically the lesion is characterized by profound changes in the contractile myofibrils known as myofibrillar degeneration. These changes have also been found in Purkinje fibers. It appears that the subendocardial hemorrhage is related to the combination of tachycardia, strong contractions (positive inotropism), and a hypovolemic ventricle. The stress myocardiopathy has a distinctly different and complex etiology. The ultrastructural lesions are not indicative of a primary hypoxic insult although hypoxia undoubtedly contributes. Author

N77-11647# Naval Air Development Center, Warminster, Pa. Crew Systems Dept.
PSYCHO-PHYSIOLOGICAL AND PHYSIO-CHEMICAL ASSESSMENT OF ACCELERATION INDUCED CHANGES IN HUMANS POSITIONED IN VARIOUS SEATBACK ANGLE CONFIGURATIONS c52

Victoria M. Voge, Harald J. VonBeckh, and Jeffry S. Bowman *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 9 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

A series of high-G tests were conducted on pilot/subjects using the multi-posture adjustable centrifuge test seat. An increase in human tolerance to sustained acceleration was demonstrated by employing several seat configurations. A significant increase in G tolerance was demonstrated with each increase in seatback angle. The position of the lower legs made no significant difference. Ten subjects between the ages of 20 and 44 with various body builds and G experience took part. All had passed the equivalent of a first class Navy flight physical, including complete spine X-rays and a determination of mental status. Some had previous G experience, either operational or in the human centrifuge, others did not. They were taking no significant medications at the time of the program, and were encouraged to eat normally, to get sufficient rest, and to avoid alcoholic beverages. The testing was carried out over a period of six weeks. The tests were carried out on the analog computer controlled, double gimbaled, dynamic flight simulator which consists of a human centrifuge having a fifty foot radius arm with the capability of attaining 40 G's in 7 seconds. S.M.

N77-11648# Royal Air Force Inst. of Aviation Medicine, Farnborough (England). Biodynamics Div.
CENTRIFUGE ASSESSMENT OF A RECLINING SEAT c54

David H. Glaister and Brian J. Lisher *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 8 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

A reclining seat has been built which would give a pilot a significant increase in acceleration tolerance whilst maintaining adequate forward vision. The effect of anti-G suit inflation has been investigated using three different pressure regimens, and positive pressure breathing (PPB) has been used to counter the added inspiratory effort which resulted from the considerable +G acceleration vector. The reclining seat alone gave an increase in tolerance of 1.4G when compared with a conventional seat; anti-G suit inflation afforded a further 1.0 to 1.6G; and PPB a further 1.0G. The combination led to relaxed greyout thresholds which averaged 7.4G in nine subjects. PPB produced a significant increase in vital capacity and restored the expiratory reserve volume to near normal levels. Subjectively, breathing became much easier. The closing volume of the lung was increased by acceleration, but was not significantly affected by PPB. However, the increase in expiratory reserve volume with PPB should lead to less airway closure during tidal breathing, with a consequent increase in arterial oxygen levels and a decreased susceptibility to acceleration atelectasis. A seat in which a near supine position is adopted with respect to the G vector, when used in conjunction with an anti-G suit and positive pressure breathing, will result in a G tolerance which is in more accord with the performance of modern military aircraft. Author

N77-11649# Texas Univ., Galveston. Medical Branch.
CORONARY FLOW AND MYOCARDIAL BIOCHEMICAL RESPONSES TO HIGH SUSTAINED +G SUB z ACCELERATION c52

H. L. Stone, L. A. Sordahl, R. T. Dowell, J. N. Lindsey, and H. H. Erickson (School of Aerospace Med.) *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 8 p refs (For primary document see N77-11644 02-51)

Avail: NTIS HC A05/MF A01

In order to determine directly the myocardial response to +Gz acceleration, miniature swine were used as the experimental subjects. Some of the animals underwent surgical implantation of flow probes around the left circumflex coronary artery and a solid-state pressure transducer in the left ventricular cavity. All of the unanesthetized instrumented subjects were exposed to multiple +Gz acceleration levels for 60 to 120 seconds on a human centrifuge. Other subjects were exposed to a single acceleration level for 120 seconds and the hearts removed for biochemical analysis 1 to 2 hours later. Mitochondria and a lysosomal fraction were isolated from the left ventricle of all animals. Mitochondrial analysis of ADP:O ratio, respiratory control index (RCI), oxygen uptake (QO2) and calcium uptake were made. Free and bound acid phosphatase measurements were made in the lysosomal fraction. Left circumflex coronary artery flow (LCCF), heart rate (HR), left ventricular pressure (LVP), and the rate of rise of LVP (P), were measured in the instrumental animals. LVP and HR increased at all levels of acceleration studied while P increased initially but would decline later. LCCF decreased at all levels of acceleration stress. The mitochondrial ADP:O ratio and the RCI were unchanged but the QO2 and calcium uptake were increased at 9 +Gz. Free acid phosphatase increased at the same level of acceleration. Author

N77-11650# Ohio State Univ., Columbus. Coll. of Veterinary Medicine.

EFFECT OF SUSTAINED +G SUB z ACCELERATION ON CARDIAC OUTPUT AND FRACTIONATION OF CARDIAC OUTPUT IN AWAKE MINIATURE SWINE c51

Robert L. Hamlin and Sidney D. Leverett, Jr. (School of Aerospace Med.) *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 6 p refs (For primary document see N77-11644 02-52)

Avail: NTIS HC A05/MF A01

Effects of sustained +Gz on cardiac rhythm and output, and on fractionation of cardiac output (CO) were studied in 12 miniature swine centrifuged, while awake, to either +3Gz or +5Gz. CO and its subfractions were measured by injecting radiolabeled microspheres into the left atrium. Percentage of CO perfusing most organs fell precipitously during +5Gz; while that to the heart increased by twofold and that to the pelvic musculature remained nearly constant. At +3Gz percentage perfusing most organs fell, but that to heart and all skeletal muscle rose twofold. When regional flow decreased, it decreased most to the eye, and next to liver, cerebrum, and renal cortex. It decreased least to the midbrain, spleen, renal medulla and gut. The profound changes in CO and fractionation of CO in awake miniature swine subjected to +Gz may represent a summation of: reflex response, a waterfall effect, or deformation of nutrient arteries. Author

N77-11651# Centro di Studi e Ricerche di Medicina Aeronautica e Spaziale, Rome (Italy).

UTILIZATION OF HUMAN CENTRIFUGE FOR TRAINING MILITARY PILOTS IN THE EXECUTION OF PROTECTIVE STRAINING MANEUVERS c54

C. A. Ramacci and G. Meineri *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 3 p (For primary document see N77-11644 02-51)

Avail: NTIS HC A05/MF A01

The importance of the utilization of human centrifuges in the training of pilots in a rational execution of protective straining maneuvers is investigated. A group of young military pilots were submitted to +Gz for comparatively long durations. During the first centrifuge run the subjects were instructed to refrain from performing any voluntary straining maneuvers. Later, the same subjects were submitted to the same acceleration pattern, accompanied, this time, by the execution of the aforesaid straining maneuvers. Exposures to G were repeated. Changes in performance and in tolerance to G were evaluated by recording morphological changes of EXG and heart rate. Subjective feelings of pilots were recorded. Author

N77-11652# School of Aerospace Medicine, Brooks AFB, Tex. Biodynamics Branch.

THE USE OF A FIXED BASE SIMULATOR AS A TRAINING DEVICE FOR HIGH SUSTAINED OR ACM (AIR COMBAT MANEUVERING) +G SUB z STRESS c54

S. D. Leverett, Jr. and R. R. Burton *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 6 p refs (For primary document see N77-11644 02-51)

Avail: NTIS HC A05/MF A01

The imposition of +Gz stress on 92 highly experienced tactical air command fighter pilots is investigated. A typical class of 22 of these pilots had an average of 1351.66 fighter hours, and were 29.04 years of age (+ or - 0.54). In this same class of 22 fighter pilots they estimated the highest G that they had ever pulled was + or - 9.0 Gz for 6.4 sec. From this data it was apparent that fighter pilots flying the F4E Phantom jet did not pull high sustained G. Therefore a centrifuge program was initiated in order to train pilots at high sustained G and at ACM G. The profile used was as follows: (1) +3 Gz/15 sec - this was an orientation run in order to familiarize the pilot with the centrifuge environment; (2) +5 Gz/45 sec - this extended run was designed to enable the pilot to learn to pace his breathing and straining maneuver properly while being exposed to G sufficient to cause the anti-G suit to inflate; (3) a final ACM type profile that exposed him initially to +5 Gz/10 sec and then proceeded to +8 Gz/30 sec, decelerated to+5 Gz/10 sec and finally the centrifuge was brought to a halt. Under these conditions the 92 pilots' heart rate and rhythm was continuously monitored. Resting heart rate for this larger group prior to initiation of the run averaged 115.93 bpm. While the maximum heart rate at +8 Gz was 167.04 bpm in all instances using a students t-test, the P value is < .001 when the heart rates at any G level are compared to the pre-run control heart rates. All of the pilots were able to complete the proposed series of runs after receiving training by the centrifuge group without a loss of vision. Author

N77-11653# EEG Research Inst., Oslo (Norway).

STRESS RESPONSE AND STRESS TOLERANCE IN FIGHTER PILOTS DURING 6 G MANOEUVERS c52

C. W. Sem-Jacobsen *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 6 p (For primary document see N77-11644 02-51)

Avail: NTIS HC A05/MF A01

EEG and EKG have been monitored from 250 active fighter pilots flying combat training involving repeated 6 G turns and pullups. 50 students and 9 pilots have been monitored while riding in the back seat of two seater fighters going through the same manoeuvers. More than half of those pilots who had committed pilots error were unconscious with convulsions following 6 G manoeuvers. Gross EEG changes were seen in the EEG. Studies of the EKG and heart rate illustrates the cardio-vascular response. The well suited pilots had a quick response with increase of heart rate when needed to maintain adequate blood supply to the brain. The unsuited groups demonstrate a slow, unsufficient cardiac response leading to brain-anoxia unconsciousness and convulsion. The student pilots and the 9 pilots fell in the same two different categories indicating a basic difference in the functioning of the autonomic nervous system in these two groups. Author

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N77-11654 Syracuse Univ., N.Y.

RECEPTOR CONTRIBUTIONS TO STEADY-STATE SENSITIVITY IN THE PERIPHERAL RETINA OF HUMAN OBSERVERS Ph.D. Thesis

John Miguel Martinez, II 1975 234 p

Avail: Univ. Microfilms Order No. 76-18539

Four psychophysical experiments are described which examine the role of interactions between signals from distinct receptor classes (rods and cones) in establishing steady-state sensitivity in the peripheral retina of the human eye. It is found that the

threshold-raising effect of a steady light field is determined by reciprocal inhibitory interactions between the rod and cone receptor systems. Results indicate that the luminance difference threshold for colored light does not reflect the sensitivity of the receptor system that is most sensitive to the test wavelength employed. Rather, the data suggest that increment thresholds are determined by spatial and temporal summation of mutually inhibitory rod and cone signals. Interactions between receptor classes, however, are not found when absolute thresholds are measured. This suggests a qualitative difference between the neural processes mediating absolute and difference thresholds in the human eye. Dissert. Abstr.

N77-11655*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POTENTIAL BIOMEDICAL APPLICATIONS OF ION BEAM TECHNOLOGY
Bruce A. Banks, Albert J. Weigand, Charles A. Babbush (Mt. Sinai Hospital, Cleveland), and Craig L. VanKampen (Case Western Reserve Univ.) 1976 20 p refs Presented at the twelfth AIAA Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976
(Grant GM-01090-14)
(NASA-TM-X-73512; E-8919) Avail: NTIS HC A02/MF A01 CSCL 06B

Electron bombardment ion thrusters used as ion sources have demonstrated a unique capability to vary the surface morphology of surgical implant materials. The microscopically rough surface texture produced by ion beam sputtering of these materials may result in improvements in the biological response and/or performance of implanted devices. Control of surface roughness may result in improved attachment of the implant to soft tissue, hard tissue, bone cement, or components deposited from blood. Potential biomedical applications of ion beam texturing discussed include: vascular prostheses, artificial heart pump diaphragms, pacemaker fixation, percutaneous connectors, orthopedic pros-thesis fixtion, and dental implants. Author

N77-11656# Johns Hopkins Univ., Baltimore, Md. Dept. of Biomedical Engineering.
PREDICTIVE MODEL OF THE AUDITORY PROCESS AS RELATED TO COMMUNICATION SYSTEMS Final Scientific Report, 1 Jan. 1971 - 31 Dec. 1975
M. B. Sachs 31 Dec. 1975 12 p refs Presented at the Spring Meeting of the Acoust. Soc. of Am., Baltimore, 1972 Submitted for publication
(Contract F44620-71-C-0024; AF Proj. 9777)
(AD-A024300; AFOSR-76-0457TR) Avail: NTIS HC A02/MF A01 CSCL 06/3

Responses from over 300 auditory nerve fibers have been systematically recorded. This is the first of neural coding in avian primary fibers. Recordings from single fibers in the cat auditory nerve under almost identical conditions were obtained for comparisons. Aside from the different ranges of characteristic frequencies the primary differences between avian and mammalian cochlear-nerve responses seem to be the higher rates of spontaneous and driven activity in the avian fibers. Further, the investigators developed a model for relating their psychophysical results in the framework of signal detection theory which accounts for the changes in psychophysical time constant with increasing fast-tone level. GRA

N77-11657# Missouri Univ., Columbia.
THE DEVELOPMENT OF CHRONIC INSERTABLE OXYGEN ELECTRODES Annual Report
Ronald E. Barr, Allen W. Hahn, and Kenneth G. Mayhan 25 Sep. 1975 26 p
(Contract DADA17-71-C-1104)
(AD-A024633) Avail: NTIS HC A03/MF A01 CSCL 06/2

An attempt is being made to develop long-term stability in oxygen sensing electrodes. Suitable designs of such electrodes would then be made for long-term insertion or implantation in tissue to chronically monitor oxygen tension. By employing techniques of pretreatment and periodic anodization to a bare-tipped electrode in saline, repeatable electrode operating characteristics have been obtained for over six days. Investigations to obtain this type of response in biological media and in vivo conditions is being attempted, using a semipermeable membrane coating on the electrode tips to ward off poisoning. A long-term in vivo electrode implantation package has been developed for use in the in vivo oxygen electrode tests. Good oxygen response has been obtained for over 30 days with this system. Author (GRA)

N77-11658# Naval Air Development Center, Warminster, Pa. Crew Systems Dept.
SAFE USE OF THE P-3 STROBE LAMP Final Report
Gloria Twine Chisum 22 Mar. 1976 10 p refs
(AD-A024036; NADC-76110-40) Avail: NTIS HC A02/MF A01 CSCL 06/18

Calculations of the retinal exposure from the P-3 strobe light and safe exposure levels have been made. Safe separation distances and safe use procedures are recommended. Author (GRA)

N77-11659# Naval Air Development Center, Warminster, Pa. Crew Systems Dept.
THE EFFECT OF PRE-ADAPTING SPECTRAL STIMULI ON VISUAL RESPONSE
Gloria Twine Chisum 30 Mar. 1976 27 p refs
(MR0410101)
(AD-A024312; NADC-76085-40) Avail: NTIS HC A03/MF A01 CSCL 06/16

Electroretinograms (ERGs) were recorded following pre-adapting exposures to radiometrically and photometrically matched spectral stimuli. The magnitudes of three aspects of the ERG varied as a function of the pre-adapting wavelength. Longer wavelength pre-adapting stimuli produced less suppression of the response parameters than stimuli from the short wavelength end of the spectrum. The implications of the findings for display design and cockpit-light-source design and management are discussed. Author (GRA)

N77-11660# Naval Coastal Systems Lab., Panama City, Fla.
IMPROVED THERMAL PROTECTION AND REWARM PROCEDURES FOR COLD WATER DIVERS
M. W. Lippitt, Jr. and G. F. Bond Feb. 1976 86 p
(AD-A024213; NCSL-271-76) Avail: NTIS HC A05/MF A01 CSCL 06/19

A series of tests were made to evaluate the thermal effectiveness of variable volume dry diving suits equipped with a NASA Project Apollo urine collection device compared to SDV wet suits. Six-hour dives at water temperatures from 35 F were successfully completed with no apparent problems except cold feet. Breathing gas consumption, oxygen consumption, and carbon dioxide production were measured during the dives which included rest, and intermittent light and moderate exercise. A rewarm technique involving the circulation of hot water around the torso area in a rewarm garment was evaluated using subjects in microchronic and acute hypothermia. The method was found to produce a rapid return to thermal equilibrium with a small rectal temperature afterdrop. Author (GRA)

N77-11661# School of Aerospace Medicine, Brooks AFB, Tex.
PRINCIPLES OF BIODYNAMICS. VOLUME 3: PHYSIOLOGICAL MECHANISMS IN THE MAMMAL UNDERLYING POSTURE, LOCOMOTION, AND ORIENTATION IN SPACE
Irving H. Wagman and Willie K. Dong Dec. 1975 100 p refs
(AF Proj. 7930)
(AD-A023691; SAM-Review-7-75-vol-3) Avail: NTIS HC A05/MF A01 CSCL 06/19

This review describes those physiological mechanisms in the peripheral and central nervous system which underlie posture, locomotion, and orientation in space. Particular emphasis is given to the input-output relationships and integration of the central nervous mechanisms. The mechanisms discussed involve many structures of the nervous system and are both gravity and nongravity dependent. The otolith organ of the vestibular labyrinth is probably the only specific gravity sensor in the vertebrate. However, gravity has a further direct effect in maintaining posture and orientation by exerting a force which results in slight stretch of the muscles of the limbs, head, and neck and thereby gives rise to reflex contractions which help maintain the body in its normal relationship in space. Nongravity-dependent mechanisms, especially those involving the semicircular canals, oculomotor system, and visual system, are also of the utmost importance in

supplementing the gravity-dependent mechanisms during all aspects of orientation. GRA

N77-11662# School of Aerospace Medicine, Brooks AFB, Tex.
THE EFFECT OF 1.6 GHz RADIATION ON NEUROTRANSMITTERS IN DISCRETE AREAS OF THE RAT BRAIN Interim Report, 1 Jan. - 1 Aug. 1975
James H. Merritt, Richard H. Hartzell, and James W. Frazer Feb. 1976 15 p refs
(AF Proj. 7757)
(AD-A023677; SAM-TR-76-3) Avail: NTIS HC A02/MF A01 CSCL 06/18

Rats were exposed to 1.6 GHz radiation at a measured power density of 80 mW/sq cm for 10 minutes. Rectal temperature rise was 4 C. Hyperthermal control rats were exposed to warm air environment to raise core temperature 4 C. Hypothalamic norepinephrine was decreased in the irradiated and hyperthermal animals compared to the normothermal controls. Hippocampal serotonin was decreased in the irradiated but not in the hyperthermal animals as was the dopamine content of the corpus striatum and hypothalamus. The changes noted fit well with power distribution determined by thermographic imagery of irradiated rats, and indicate that these changes are the result of the microwave-induced hyperthermia. Author (GRA)

N77-11663# Office of Naval Research, London (England).
AQUEOUS ARTEFACTS: THE RIDDLE OF BOUND WATER
J. B. Bateman Apr. 1976 25 p refs
(AD-A024643; ONRL-R-3-76) Avail: NTIS HC A02/MF A01 CSCL 07/2

This paper, intended for the general reader, first discusses early ideas about water binding in biological systems. More recent work is presented in the form of a report and commentary on lectures given during a Royal Society discussion meeting, together with occasional references to other literature and to papers given at a somewhat similar symposium in Roscoff. The conclusion to be drawn is probably that although the acceptable definition of bound water is in doubt and the interpretation of experimental data frequently ambiguous, water binding to biological macromolecules to the extent of about 0.3 - 0.5 g.water/g.dry weight is fairly general. Further, there is evidence that the rates of many biological reactions may be controlled both by direct consumptive participation and by catalytic shifts of water molecules attached in and around receptor sites. A current controversy concerning the role of 'structured' water in active transport recalls similar disputes among the earlier proponents and opponents of water binding, dating probably from Overton's introduction of the idea in 1902. GRA

N77-11664# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
CARDIOVASCULAR, RENAL AND RESPIRATORY EFFECTS OF HIGH INTENSITY, INTERMEDIATE DURATION, LOW FREQUENCY VIBRATION Interim Scientific Report, 1 Jun. 1974 - 30 Jun. 1975
Robert M. Nerem and Robert L. Hamlin 18 Jul. 1975 47 p refs
(Grant AF-AFOSR-2526-73; AF Proj. 9777; OSURF Proj. 3656-A)
(AD-A025098; AFOSR-76-0545TR; Rept-3656-2; ISR-2) Avail: NTIS HC A03/MF A01 CSCL 06/19

A research program on the influence of high intensity, intermediate duration, low-frequency wholebody vibration on the cardiovascular, renal and respiratory system is described. During the period 1 June 1974 to 30 June 1975, the major emphasis was on the in vitro study of the transport of I 131-albumin between blood and the arterial wall in the presence of oscillatory flow and pressure conditions. A previous series of in vivo experiments has also been extended to include the frequencies of 6 and 14 Hz. These in vivo data indicate an enhancement of albumin uptake in the dog aorta in the presence of vibration and are consistent with the in vitro data and the concept of a shear dependent transport process. An in vitro study of blood-arterial wall cholesterol transport has also been initiated and in vivo measurements of aortic pressure and velocity waveforms in the presence of wholebody vibration are being continued. Author (GRA)

N77-11645# School of Aerospace Medicine, Brooks AFB, Tex.
CHANGES IN CLINICAL CARDIOLOGIC MEASUREMENTS ASSOCIATED WITH HIGH +G SUB z STRESS
Kent K. Gillingham and Phelps P. Crump *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 9 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

N77-11647# Naval Air Development Center, Warminster, Pa. Crew Systems Dept.
PSYCHO-PHYSIOLOGICAL AND PHYSIO-CHEMICAL ASSESSMENT OF ACCELERATION INDUCED CHANGES IN HUMANS POSITIONED IN VARIOUS SEATBACK ANGLE CONFIGURATIONS
Victoria M. Voge, Harald J. VonBeckh, and Jeffry S. Bowman *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 9 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

N77-11649# Texas Univ., Galveston. Medical Branch.
CORONARY FLOW AND MYOCARDIAL BIOCHEMICAL RESPONSES TO HIGH SUSTAINED +G SUB z ACCELERATION
H. L. Stone, L. A. Sordahl, R. T. Dowell, J. N. Lindsey, and H. H. Erickson (School of Aerospace Med.) *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 8 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

N77-11653# EEG Research Inst., Oslo (Norway).
STRESS RESPONSE AND STRESS TOLERANCE IN FIGHTER PILOTS DURING 6 G MANOEUVERS
C. W. Sem-Jacobsen *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 6 p (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N77-11665 Colorado Univ., Boulder.
MAJOR GENE ANALYSIS: AN ALTERNATIVE APPROACH TO THE STUDY OF THE GENETICS OF HUMAN BEHAVIOR Ph.D. Thesis
Pamela Rae Fain 1976 121 p
Avail: Univ. Microfilms Order No. 76-23607

Expectations for the relationship between sibship mean and sibship variance when a quantitative character is influenced by a major gene were derived. An autosomal additive locus, a locus with complete dominance, a sex-linked additive locus and a sex-linked dominant were considered. In every case, a systematic relationship between sibship variance and sibship mean was shown to exist. These patterns were confirmed in samples of data simulated to fit a number of genetic models by testing the effects of the linear, quadratic and cubic terms of sibship mean on the logarithm of sibship variance. Maximum likelihood distribution analyses of simulated samples indicated that this technique may be very useful in decomposing mixtures of genotypic distributions. In general, however, the hypothesis that a single normal distribution also fits the data can rarely be rejected, and the method may be very sensitive to unequal variance within genotypes. Dissert. Abstr.

N77-11666*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL STUDY FOR DETERMINING HUMAN

DISCOMFORT RESPONSE TO ROLL VIBRATION
Jack D. Leatherwood, Thomas K. Dempsey, and Sherman A. Clevenson Nov. 1976 29 p refs
(NASA-TN-D-8266; L-10789) Avail: NTIS HC A03/MF A01 CSCL 05H

An experimental study using a passenger ride quality apparatus (PRQA) was conducted to determine the subjective reactions of passengers to roll vibrations. The data obtained illustrate the effect upon human comfort of several roll-vibration parameters: namely, roll acceleration level, roll frequency, and seat location (i.e., distance from axis of rotation). Results of an analysis of variance indicated that seat location had no effect on discomfort ratings of roll vibrations. The effect of roll acceleration level was significant, and discomfort ratings increased markedly with increasing roll acceleration level at all roll frequencies investigated. Of particular interest, is the fact that the relationship between discomfort ratings and roll acceleration level was linear in nature. The effect of roll frequency also was significant as was the interaction between roll acceleration level and roll frequency. Author

N77-11667*# Boeing Co., Wichita, Kans.
USER EVALUATION OF RIDE TECHNOLOGY RESEARCH Final Report
J. R. McKenzie and S. H. Brumaghim Washington NASA Nov. 1976 63 p refs
(Contract NAS1-13908)
(NASA-CR-2746; D3-11015-1) Avail: NTIS HC A04/MF A01 CSCL 05H

The 23 organizations queried represent government, carrier, and manufacturing interests in air, marine, rail, and surface transportation systems. Results indicate a strong need for common terminology and data analysis/reporting techniques. The various types of ride criteria currently in use are discussed, particularly in terms of their respective data base requirements. A plan of action is proposed for fulfilling the ride technology needs identified by this study. Author

N77-11668# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
S2 PROBABILITY AND CNV (CONTINGENT NEGATIVE VARIATION)
R. Naeaetaenen, A. W. K. Gaillard, and S. Maentysalo 1975 9 p refs
(IZF-1975-11; TDCK-66921) Avail: NTIS HC A02/MF A01

The relationship between the CNV and expectancy which was operationalized as the probability of the occurrence of S2 was investigated. Five within-block probabilities were used: .10, .30, .50, .70, .90, and 1.00. It was attempted to separate the effects of motor preparation and expectancy by comparing the probability effect on the CNV in a reaction time task with that in a signal detection task. Because largest amplitudes were obtained at sub-maximal probabilities, the CNV seems to be related more to event-uncertainty than to expectancy. The results are difficult to interpret because of the low amplitudes obtained, especially in the signal-detection condition. The low amplitudes are explained in two ways. First, it is possible that, a motor response is a necessary condition to secure a reasonable size of CNV; second, in the reaction-time task motor preparation may be suppressed by the low discriminability of S2. Author (ESA)

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N77-11669 Carnegie-Mellon Univ., Pittsburgh, Pa.
AN APPLICATION OF WIENER ANALYSIS TO HUMAN VISUAL PSYCHOPHYSICAL RESPONSE Ph.D. Thesis
Larry Allen Abel 1976 200 p
Avail: Univ. Microfilms Order No. 76-23469

The correlation in time presented by Lee Schetzen is replaced by ensemble averaging down a set of stimulus waveforms. This method of analysis is suited for use in those areas of visual psychophysics where the input is a grating of fixed spatial extent and the output is some number corresponding to the perceived contrast of the grating. Expressions for the variance of the kernel estimates produced by this technique are given. Models of the contrast perception mechanism are developed in both spatial domain or single channel and frequency domain or multiple channel configurations. These models were analyzed using the adaptation of Wiener analysis previously presented. Some of the frequency domain models were also studied analytically by representing them in terms of a Taylor series expansion.
Dissert. Abstr.

N77-11670*# Scientific Translation Service, Santa Barbara, Calif.
EQUIPMENT FOR THE COSMONAUT
Ts. Olegov and G. Sergeyev Washington NASA Nov. 1976 20 p Transl. into ENGLISH from Nauka i Zhizn (USSR), no. 9, Sep. 1976 p 27-32
(Contract NASw-2791)
(NASA-TT-F-17275) Avail: NTIS HC A02/MF A01 CSCL 13I

Problems are discussed for technical maintenance in space, and the instruments to be used for this purpose. Methods of using these instruments under weightless conditions are also described. Author

N77-11671*# Umpqua Research Co., Myrtle Creek, Ore.
ELECTROLYTIC PRETREATMENT UNIT GASEOUS EFFLUENT CONDITIONING Final Report
Gerald V. Colombo and David F. Putnam Aug. 1976 53 p refs
(Contract NAS9-14217)
(NASA-CR-151101; URC-60801) Avail: NTIS HC A04/MF A01 CSCL 06B

The electrolytic pretreatment of urine is an advanced process that eliminates the need for handling and storing the highly corrosive chemicals that are normally used in water reclamation systems. The electrolytic pretreatment process also converts the organic materials in urine to gases (N2 and O2) that can be used to replenish those lost to space by leakage, venting, and air lock operations. The electrolytic process is more than a pretreatment, since it decreases the urine solids content by approximately one third, thus reducing the load and eventual solids storage requirements of the urine processing system. The evolved gases from the pretreatment step cannot, however, be returned directly to the atmosphere of a spacecraft without first removing several impurities including hydrogen, chlorine, and certain organic compounds. A treatment concept was developed that would decrease the impurities in the gas stream that emanates from an electrolysis unit to levels sufficiently low to allow the conditioned gas stream to be safely discharged to a spacecraft atmosphere. Two methods were experimentally demonstrated that can accomplish the desired cleanup. The bases of the two methods are, repectively: (1) raw urine scrubbing and (2) silica gel sorption. Author

N77-11672*# Life Systems, Inc., Cleveland, Ohio.
EVALUATION OF A SPACECRAFT NITROGEN GENERATOR Annual Status Report
R. D. Marshall and J. D. Powell Sep. 1976 68 p refs
(Contract NAS2-8732)
(NASA-CR-137930; LSI-ER-251-10-1) Avail: NTIS HC A04/MF A01 CSCL 06K

A method is discussed of generating nitrogen for cabin leakage makeup aboard space vehicles having longer duration missions. The nitrogen generation concept is based on using liquid hydrazine as the stored form of nitrogen to reduce the higher tankage and expendables weight associated with high pressure gaseous or cryogenic liquid nitrogen storage. The hydrazine is catalytically dissociated to yield a mixture of nitrogen and hydrogen. The nitrogen/hydrogen mixture is then separated to yield the makeup nitrogen. The excess supply of hydrogen would be available for use in the reduction of metabolic carbon dioxide. A detailed comparison was completed of Palladium/Silver and Polymer Electrochemical-based Nitrogen Generation Systems. The palladium/silver-based system was judged better than the Polymer Electrochemical Nitrogen Generation System because of lower expendable weight and palladium/silver nitrogen/hydrogen separation represents 'off-the-shelf' technology. Author.

N77-11673*# Vought Corp., Dallas, Tex. Systems Div.
DEVELOPMENT AND FABRICATION OF AN ADVANCED LIQUID COOLING GARMENT Final Report
J. R. Leith and C. W. Hixon 22 Oct. 1976 87 p refs
(Contract NAS2-9026)
(NASA-CR-137974; Rept-2-53230/6R-51388) Avail: NTIS HC A05/MF A01 CSCL 06Q

The elastomeric film fin/tube concept which was developed is a composite of polyurethane film, fine expanded silver mesh, a serpentine pattern polyurethane transport tubing and an integral comfort liner, all bonded via adhesive application and vacuum-bagged for final cure. As demonstrated by thermal analysis, the composite garment material is capable of removing a 293 watt (1000 BTU/hr) metabolic load through a head and torso cooling area of .46 sq m (5 sq ft) with tube spacing of slightly under one inch. A total of 60 test elements, each .15m x .15m (6 in. x 6 in.) were fabricated in support of the liquid cooling garment concept development. In parallel with the fabrication of these elements a continuing series of laboratory tests to support the fabrication techniques was carried out. The elements and supporting tests are described. Author

N77-11674*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOT WORKLOAD AND FATIGUE: A CRITICAL SURVEY OF CONCEPTS AND ASSESSMENT TECHNIQUES
Walter B. Gartner (Adex Systems) and Miles R. Murphy Washington Nov. 1976 60 p refs
(NASA-TN-D-8365; A-6630) Avail: NTIS HC A04/MF A01

The principal unresolved issues in conceptualizing and measuring pilot workload and fatigue are discussed. These issues are seen as limiting the development of more useful working concepts and techniques and their application to systems engineering and management activities. A conceptual analysis of pilot workload and fatigue, an overview and critique of approaches to the assessment of these phenomena, and a discussion of current trends in the management of unwanted workload and fatigue effects are presented. Refinements and innovations in assessment methods are recommended for enhancing the practical significance of workload and fatigue studies. Author

N77-11675*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ASTP CHEMICAL AND MICROBIOLOGICAL ANALYSIS OF POTABLE WATER
Richard L. Sauer and Scott A. Leslie Oct. 1976 12 p refs
(NASA-TM-X-58192; JSC-11578) Avail: NTIS HC A02/MF A01 CSCL 06K

The Apollo-Soyuz Test Project procedures for potable water system servicing and the results of preflight and postflight chemical and microbiological analyses of the water are discussed. Tables show results of the analyses. The effectiveness of the water system is evaluated. Author

N77-11676*# Umpqua Research Co., Myrtle Creek, Ore.
DEVELOPMENT ASSESSMENT OF WASH WATER RECLAMATION Final Report
David F. Putnam Aug. 1976 90 p refs
(Contract NAS2-8239)
(NASA-CR-137934; URC-60806) Avail: NTIS HC A05/MF A01 CSCL 06K

An analytical study assessment of state-of-the-art wash water reclamation technology is presented. It covers all non-phase-change unit operations, unit processes and subsystems currently under development by NASA. Each approach to wash water reclamation is described in detail. Performance data are given together with the projected weights and sizes of key components and subsystems. It is concluded that a simple multifiltration subsystem composed of surface-type cartridge filters, carbon adsorption and ion exchange resins is the most attractive approach for spacecraft wash water reclamation in earth orbital missions of up to 10 years in duration. Author

N77-11677*# Energy Research Corp., Danbury, Conn.
DEVELOPMENT OF A PROTOTYPE REGENERABLE CARBON DIOXIDE ABSORBER
Michael Onischak 10 Sep. 1976 26 p refs
(Contract NAS2-8644)
(NASA-CR-137919) Avail: NTIS HC A03/MF A01 CSCL 06K

Design information was obtained for a new, regenerable carbon dioxide control system for extravehicular activity life support systems. Solid potassium carbonate was supported in a thin porous sheet form and fabricated into carbon dioxide absorber units. Carbon dioxide and water in the life support system atmosphere react with the potassium carbonate and form potassium bicarbonate. The bicarbonate easily reverts to the carbonate by heating to 150 deg C. The methods of effectively packing the sorbent material into EVA-sized units and the effects of inlet concentrations, flowrate, and temperature upon performance were investigated. The cycle life of the sorbent upon the repeated thermal regenerations was demonstrated through 90 cycles. Author

N77-11678# Committee on Science and Technology (U. S. House).
CREW TRAINING AND SUPPORT ACTIVITIES
Washington GPO 1976 49 p Hearing before Subcomm. on Space Sci. and Applications of Comm. on Sci. and Technol., 94th Congr., 2d Sess., 22 Jun. 1976
(GPO-75-984) Avail: Subcomm. on Space Sci. and Applications

The current status of crew training for the space shuttle program is briefly reviewed. J.M.S.

N77-11679# Stanford Univ., Calif. Dept. of Civil Engineering.
CONTINUING RESEARCH IN THE DEVELOPMENT OF INTERACTIVE MAN-COMPUTER SYSTEMS FOR ENGINEERING-CONSTRUCTION PROJECTS Final Report, 1 Apr. 1974 - 30 Sep. 1975
Boyd C. Paulson, Jr. Sep. 1975 68 p refs
(Grant NSF GK-42132)
(PB-252927/9; TR-200; NSF/GK-42132/SU-TR-200) Avail: NTIS HC A04/MF A01 CSCL 13B

An interactive man-computer environment is reported to develop, implement and test hypotheses and systems involving integrated network models for the planning and control of resources and operations on large engineering-construction projects. Examples include rapid transit systems, nuclear power plants, and mining developments. GRA

N77-11680# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Industrial Engineering and Operations Research.
COMPUTERIZED ANALYSIS OF EYE MOVEMENTS DURING STATIC DISPLAY VISUAL SEARCH Interim Report, Jun. 1973 - Apr. 1975
Harry Snyder and Donald F. Taylor Wright-Patterson, AFB, Ohio AMRL Feb. 1976 78 p refs
(Contract F33615-71-C-1739; AF Proj. 7183)
(AD-A024100; AMRL-TR-75-91) Avail: NTIS HC A05/MF A01 CSCL 17/8

A computerized analysis technique was developed for the evaluation of eye movements. This technique, when applied to eye movement data of 1 millisecond temporal resolution, is considered useful to evaluate such eye movement parameters as fixation duration, interfixation distance, and number of fixations per trial. This analysis technique was evaluated for displays having a single target and up to 192 nontargets in a static display. The results indicate that fixation duration is unaffected by the density of nontargets, but that the mean interfixation distance decreases linearly with increases in nontarget density. Due to this decrease in interfixation distance, the search time and the number of fixations per trial increase linearly with the density of nontargets. An overall evaluation of the eye movement measuring device is offered. Author (GRA)

N77-11681# GCA Corp., Bedford, Mass. Technology Div.
DESIGN, DEVELOPMENT, FABRICATION AND TESTING OF A PORTABLE SELF-CONTAINED RESPIRABLE DUST MASS MONITOR
Pedro Lilienfeld 25 Oct. 1974 58 p refs
(Contract H0232039)
(PB-254503/6; BM-OFR-73-76) Avail: NTIS HC A04/MF A01 CSCL 14B

An airborne mass monitor for unattended and recording measurements of the concentration of dust in mining environments is described. Sensing collection are performed by beta-radiation attenuation and inertial implementation, respectively. The instrument is portable, battery or line operated provides a digital printout of the mass concentration during each selection sampling period, as well as the accumulated mass of dust, and the elapsed sampling time. GRA

N77-11682# Frankford Arsenal, Philadelphia, Pa.
REDUCTION OF TARGET DETECTABILITY BY LASER PROTECTIVE MATERIALS
Gerald C. Hoist Apr. 1976 22 p refs
(DA Proj. 1T1-61102-AH-46)
(AD-A024383; FA-TR-76021) Avail: NTIS HC A02/MF A01 CSCL 05/5

An ideal laser protection material will provide the required optical density at the laser wavelength and be transparent at all other wavelengths. Although there are many ways to formulate a quality factor, the present study examines a method of combining luminous transmission with the detectability of low contrast targets. The present study examines how detectability of low contrast targets is affected by two popular ruby laser protectors. In order to study the effect of color rendition only, neutral density filters were used to equate the luminous transmission of the two goggles. Theoretical considerations of how these goggles might perform is given. To obtain the effects of protective materials on detectability, the contrast required for the detection of various achromatic targets was measured. The targets consisted of fourteen gratings which subtended visual angles from 2.26 minutes per line pair up to 68.4 minutes per line pair. GRA

N77-11683# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
DYNAMIC CONTRAST REQUIREMENTS Final Report
Leon G. Williams and Judith M. Erickson Feb. 1976 93 p refs
(Contract N00014-74-C-0076; NR Proj. 215-229)
(AD-A023973; Rept-76-SRC/6; ONR-CR215-229-2F) Avail: NTIS HC A05/MF A01 CSCL 05/5

Three experiments were conducted to investigate the spatial and temporal relationship between the human visual system and displayed imagery. In Experiment I, contrast sensitivity for sinusoidal gratings was determined as a function of spatial frequency, temporal frequency, luminance, and stimulus position on the retina. In Experiment II, contrast sensitivity for sinusoidal grids was determined as a function of the horizontal and vertical spatial frequency, and temporal frequency. In Experiment III, sinusoidal grating targets on grating surrounds were used to determine contrast sensitivity as a function of target spatial frequency, surround spatial frequency, and temporal frequency. The data from the three experiments indicate how much contrast is required under specified conditions to just detect a noise-free target defined in terms of its spatial and temporal frequency content. The results provide a means for predicting the visibility of targets in real displays. GRA

N77-11684# Human Engineering Labs., Aberdeen Proving Ground, Md.
INFLUENCE OF PILOT INCAPACITATION ON LOW SPEED AND HOVERING FLIGHT Final Technical Report
Douglas P. Harvey and John D. Waugh Jan. 1976 37 p refs
(AD-A023728; HEL-TM-7-76) Avail: NTIS HC A03/MF A01 CSCL 05/5

Very little quantitative information exists as to survivability of a lone or surviving helicopter pilot who is incapacitated by wounds received during a mission. Since the pilot normally uses all four limbs, his ability to maintain control of an otherwise flyable aircraft is expected to be impaired. A safe, yet realistic approach to the investigation was to physically restrain single hands, limbs, etc. of Army aviators hovering a DHT-1 Whirlymite Trainer--a semitethered but otherwise genuine single-place helicopter. The relative accuracy with which subjects followed a prescribed flight path under the restraints was the primary means of comparison. Statistical analysis of integrated error scores showed that the only effective restraints were those involving an entire limb. Since this investigation only involved hovering flight, recommendations included further work in cruise considerations in favor of multiple-limb restraints. GRA

N77-11685# Michigan Univ., Ann Arbor. Mental Health Research Inst.
TARGET DETECTION IN RAPIDLY-CHANGING VISUAL SEQUENCES Final Report
Irwin Pollack Mar. 1976 32 p refs
(Contract N00014-67-A-0181-0051; NR Proj. 197-022)
(AD-A023784) Avail: NTIS HC A03/MF A01 CSCL 05/10

Sequences of digits were painted upon a display scope under conditions of a stationary window (window fixed, moving sequence) and of a moving window (sequence fixed, moving window). Performance was examined under a variety of window-sizes and rates of presentation. Unlike the reading of English text with long-term sequential constraints, the present task could be specified by only two successive digits. Nevertheless, the accuracy of target detection improved with window size in a manner not unlike that reported for English text. The results are discussed. GRA

N77-11686# Systems Research Labs., Inc., Dayton, Ohio.
COMPARISON OF HUMAN INFORMATION PROCESSING PERFORMANCE WITH DOT AND STROKE ALPHABETIC CHARACTERS Interim Report, Jan. 1974 - Jun. 1975
Robert D. ODonnell and Frank E. Gomer Jan. 1976 23 p refs
(Contract F33615-72-C-0235; AF Proj. 7184)
(AD-A024099; AMRL-TR-75-95) Avail: NTIS HC A02/MF A01 CSCL 05/5

Recent engineering developments have stimulated interest in the use of displays which will present alphanumeric information in dot format. In order to supply human factors data on how information presented in punctate form is processed, the Sternberg item recognition procedure was used and discrimination reaction time (RT) to both dot and stroke letters was determined under various amounts of memory load. In addition, the visually evoked response (VER) of the electroencephalogram was recorded during RT performance and compared as a function of symbology format. These results suggest that dot letters require slightly longer (less than 10 msec) to encode than stroke letters. However, subsequent to about 200 msec after the letter is presented, no statistically significant differences appear in either RT or VER data, suggesting that once the letter is encoded it is processed equally well whether the original format was dot or stroke. In addition, no evidence of increased work load, greater errors, or other performance decrement was seen with the dot format used here. Under the conditions tested, subjects were apparently able to compensate for the additional encoding time with little effort and with no demonstrable effect on overall performance. GRA

N77-11687# Illinois Univ., Urbana. Aviation Research Lab.
ENHANCEMENT OF HUMAN EFFECTIVENESS IN SYSTEM DESIGN, TRAINING, AND OPERATION: JULY 1974 - JUNE 1975 Final Report
Stanley N. Roscoe and Charles O. Hopkins Jul. 1975 35 p refs
(Contract F44620-70-C-0105; AF Proj. 9778)
(AD-A023941; ARL-75-21/AFOSR-75-10; AFOSR-76-0476TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

This report is part of a study on residual attention, information load, and pilot performance. It has resulted in: (1) General rules and prediction equations for evaluation of task load and operator efficiency; (2) Discrimination of individual differences in attention and assessment of their predictive validity to operational performance; (3) Development of training procedures for timesharing; and (4) Application of feedback control theory to operator tracking performance in timesharing. Investigation of adaptive logic in acquisition of perceptual-motor skills included a review of literature on adaptive training with emphasis on current theoretical models of perceptual motor skills. Experiments were designed to investigate the role of proprioceptive and visual response-produced feedback during motor learning, and the effects of changing response-produced feedback after the same or after different amounts of practice. GRA

N77-11688# Illinois Univ., Urbana. Coordinated Science Lab.
CONTROL AND TRAJECTORY OPTIMIZATION OF A ROBOT

ARM
Kar-Keung David Young Nov. 1975 218 p refs Sponsored in part by NSF
(Contract DAAB07-72-C-0259; Grant AF-AFOSR-2570-73)
(AD-A023669; R-701; UILU-ENG-75-2236) Avail: NTIS HC A10/MF A01 CSCL 06/4

In the past few years robot arms or computer-controlled manipulators have been developed in several Artificial Intelligence research laboratories in the United States. The purpose of designing and building these robot arms is to use them as devices to perform physical tasks. The movements of the robot arms are required to be similar to humans'. Conventional positioning servos implemented on industrial robots are no longer applicable. This study concentrates on finding optimal arm trajectories and possible control strategies for a two-link robot arm whose motion is confined to the vertical plane. As the mathematical model for a six-degrees-of-freedom robot arm is highly nonlinear, it is intended to first investigate a simpler arm and hopefully develop control strategies that can be generalized to the more complex arms. Various approaches are taken towards trajectory optimization. An optimal feedback control scheme is developed for this arm and is generalizable to the six-degrees-of-freedom robot arm. GRA

N77-11689# Pritsker and Associates, Inc., West Lafayette, Ind.
SAINT II DOCUMENTATION MANUAL Final Report
David B. Wortman, C. Elliott Sigal, A. Alan B. Pritsker, and Deborah J. Seifert Wright-Patterson AFB, Ohio AMRL Dec. 1975 229 p refs
(Contract F33615-74-C-4005; AF Proj. 7184)
(AD-A024286; AMRL-TR-75-116; AMRL-HESS-74-4) Avail: NTIS HC A11/MF A01 CSCL 05/5

A network modeling and analysis technique called SAINT II has been developed to model and analyze complex Air Force man-machine systems. The modeling vehicle developed is a set of network symbols and terminology and the analysis vehicle is computer simulation. SAINT 2 obtains system performance measures for networks that represent a mission consisting of a set of tasks performed by a crew of operators having a complement of equipment in the face of environmental factors. These system performance measures are obtained via a simulation approach. Human engineering considerations are reflected in the modeling technique by means of task parameter specifications, task precedence and sequencing relations, and psycho-social and environmental factors affecting crew performance. This report describes the SAINT 2 simulation program, which includes a number of new capabilities not available in the original SAINT program. GRA

N77-11648# Royal Air Force Inst. of Aviation Medicine, Farnborough (England). Biodynamics Div.
CENTRIFUGE ASSESSMENT OF A RECLINING SEAT
David H. Glaister and Brian J. Lisher *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 8 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

N77-11651# Centro di Studi e Ricerche di Medicina Aeronautica e Spaziale, Rome (Italy).
UTILIZATION OF HUMAN CENTRIFUGE FOR TRAINING MILITARY PILOTS IN THE EXECUTION OF PROTECTIVE STRAINING MANEUVERS
C. A. Ramacci and G. Meineri *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 3 p (For primary document see N77-11644 02-51) Avail: NTIS HC A05/MF A01

N77-11652# School of Aerospace Medicine, Brooks AFB, Tex. Biodynamics Branch.
THE USE OF A FIXED BASE SIMULATOR AS A TRAINING DEVICE FOR HIGH SUSTAINED OR ACM (AIR COMBAT MANEUVERING) +G SUB z STRESS
S. D. Leverett, Jr. and R. R. Burton *In* AGARD The Pathophysiol. of High Sustained +G sub z Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training Oct. 1976 6 p refs (For primary document see N77-11644 02-51)
Avail: NTIS HC A05/MF A01

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering*.

N77-11690 California Univ., Los Angeles.
ANALYSIS AND DESIGN OF RELATIONAL SCHEMATA FOR DATABASE SYSTEMS Ph.D. Thesis
Carlo Antonio Zaniolo 1976 226 p
Avail: Univ. Microfilms Order No. 76-22226

A database system architecture which, for the purpose of obtaining a high degree of data independence and users' convenience, employs three distinct levels of data representation. The conceptual schema supplies the logical frame of reference from which the users can construct their application subschemata, and the database administrator designs the organization of the physical files which is modeled by the implementation schema. A specialization of the relational model according to the level at which it is used is proposed. Admissible minimal cover graphs, recast as second order relations are proposed for the conceptual schema. Dissert. Abstr.

N77-11691 Syracuse Univ., N.Y.
SYSTEM DESIGN OF FUNCTIONAL MEMORY BASED PROCESSORS Ph.D. Thesis
George Edwin Rossmann 1975 149 p
Avail: Univ. Microfilms Order No. 76-18557

A determination is made of what bus and control structures are appropriate for FM based processors. These results are then integrated with the techniques of table design in the development of an FM based system design for the PDP-11 architecture. Microprograms for the PDP-11 interpreter are written, and detailed logic design of much of the host processor is done. The FM based interpreter is shown to perform on a par with a medium scale PDP-11 processor, the PDP-11/40. This validates the effectiveness of system design based upon the FM technology. The system design of an FM based interpreter for the SNOBOL4 pattern matching statement is shown. This illustrates the feasibility of direct hardware support of high level programming languages with a functional memory based host system. Dissert. Abstr.

N77-11692 Rice Univ., Houston, Tex.
A HIERARCHICAL RESTRUCTURABLE MULTI-MICROPROCESSOR ARCHITECTURE Ph.D. Thesis
Robert Glen Arnold 1976 166 p
Avail: Univ. Microfilms Order No. 76-21662

The system architecture described is based on a large collection of identical system modules each containing a microcomputer. These system modules may be loosely coupled to support a high degree of independence and local autonomy. The control structures for this architecture are modular in nature and promotes the hierarchical distribution of control by recursively organizing the system modules into teams. Each team consists of a single master and a set of subordinates that may also be processor teams. In addition, system modules may be coupled together to provide an extended (multi-precision) arithmetic ability. The interprocessor communication and control structure is analyzed to determine estimates of the expected system performance. An estimate of the system overhead inherent in the communication and structuring mechanism is discussed and provides a basis for general strategies of system application. The relationship is demonstrated of the software to the system architecture. Examples are presented which illustrate the utility of the system and its ease of application. Dissert. Abstr.

N77-11693*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FIRST-ORDER-HOLD INTERPOLATION DIGITAL-TO-ANALOG CONVERTER WITH APPLICATION TO AIRCRAFT SIMULATION
William B. Cleveland Washington Nov. 1976 19 p
(NASA-TN-D-8331; A-6546) Avail: NTIS HC A02/MF A01 CSCL 09B

Those who design piloted aircraft simulations must contend with the finite size and speed of the available digital computer and the requirement for simulation reality. With a fixed computational plant, the more complex the model, the more computing cycle time is required. While increasing the cycle time may not degrade the fidelity of the simulated aircraft dynamics, the larger steps in the pilot cue feedback variables (such as the visual scene cues), may be disconcerting to the pilot. The first-order-hold interpolation (FOHI) digital-to-analog converter (DAC) is presented as a device which offers smooth output, regardless of cycle time. The Laplace transforms of these three conversion types are developed and their frequency response characteristics and output smoothness are compared. The FOHI DAC exhibits a pure one-cycle delay. Whenever the FOHI DAC input comes from a second-order (or higher) system, a simple computer software technique can be used to compensate for the DAC phase lag. When so compensated, the FOHI DAC has (1) an output signal that is very smooth, (2) a flat frequency response in frequency ranges of interest, and (3) no phase error. When the input comes from a first-order system, software compensation may cause the FOHI DAC to perform as an FOHE DAC, which, although its output is not as smooth as that of the FOHI DAC, has a smoother output than that of the ZOH DAC. Author

N77-11694# Los Alamos Scientific Lab., N.Mex.
DEVELOPMENTAL SYSTEM FOR MICROCOMPUTER BASED INTELLIGENT GRAPHICS TERMINALS
R. Kellner and L. D. Maas 1976 13 p refs Presented at Graphics 76 Meeting, Philadelphia, 14 Jul. 1976
(Contract W-7405-eng-36)
(LA-UR-76-125; Conf-760702-1) Avail: NTIS HC A02/MF A01

A low cost intelligent graphics terminal for developmental work consisting of a Tektronix storage tube terminal and an ALTAIR 8800 microcomputer is described. The microcomputer system is used to developed and debug customized intelligent terminal configurations and features before a production model is finalized and fabricated. This allows flexibility in terminal design and allows changes to be tried easily before final versions are built. The customized terminal features that are described are the abilities to process a segmented display file, to provide refresh of up to 130 characters or vectors, to control accessory devices such as a flexible disc and a graphics table, to provide data compression of over 60 percent on large pictures, and to provide a local debugging utility. Author (ERA)

N77-11695# Energy Research and Development Administration, Oak Ridge, Tenn. Technical Information Center.
ERDA ENERGY INFORMATION DATA BASE: MAGNETIC TAPE DESCRIPTION
Feb. 1976 19 p refs
(TID-4581-R3) Avail: NTIS HC A02/MF A01

The feasibility of establishing an energy center at Glasgow Air Force Base, near Glasgow, Montana was studied. A preliminary analysis of the energy situation of the Montana region is presented along with the pressing regional needs for high BTU gas and petroleum crude oil, or equivalents. With the relative proximity of major coal resources in the Fort Union Coal Region, particular effort was applied to coal conversion as the basis for a potential energy park at Glasgow AFB. Detailed process analysis and preliminary economics for a coal conversion, energy production complex are also presented with brief consideration of alternate energy center concepts, including a nuclear energy center and multipurpose, energy-agro-industrial park. ERA

N77-11696# Stanford Univ., Calif. Dept. of Industrial Engineering.
COMPUTER GRAPHICS APPLICATIONS IN TRANSPORTATION INFORMATION SYSTEMS
Frank B. Wingate Aug. 1975 36 p
(Grant UMTA-CA-11-0008)
(PB-254795/8; RR-23; UMTA-CA-11-0008-75-1) Avail: NTIS HC A03/MF A01 CSCL 09C

Primary emphasis was placed on development of a graphics application package to control the existing transit information system. Other areas of investigation included operator interaction with the computer display; sorting and searching a large geographic data base; and the practical limitations of geographic displays on a CRT. The U.S. Census Bureau's DIME data base was analyzed, and an interactive graphics map editor was developed. GRA

N77-11697# Stanford Univ., Calif. Digital Systems Lab.
AN EFFICIENT IMPLEMENTATION OF MONITORS AND CONDITION VARIABLES
Ashok R. Saxena Aug. 1975 26 p refs
(Contract N00014-67-A-0112-0044; AF Proj. 7151)
(AD-A023931; SU-TN-72) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper presents a proposal for an implementation of monitors and condition variables. The proposed implementation allows the use of a large number of monitors and condition variables with main memory requirements proportional to the number of concurrent processes and the maximum depth of nested monitor calls. The proposed implementation is useful for operating systems with a fixed (and small) number of concurrent processes with virtual memory. Author (GRA)

N77-11698# Michigan Univ., Ann Arbor. Systems Engineering Lab.
DATA STRUCTURES: SPECIFICATION AND REALIZATION Interim Report, 1 Oct. 1975 - 1 Jan. 1976
Francois Marc Bancilhon and Keki B. Irani Griffiss AFB, N. Y. RADC Mar. 1976 251 p refs
(Contract F30602-76-C-0029; AF Proj. 5581)
(AD-A024396; RADC-TR-76-68) Avail: NTIS HC A12/MF A01 CSCL 09/2

A general model for the study of data structures is presented. The model is structured by the introduction of a notion of equivalence between relational configuration and a notion of realization of a relational schema by an access-path schema. A specific example of a data structure problem is presented, showing the value of the model and the practical interest of defined concepts. GRA

N77-11699# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
GRAPHICS SYSTEM MODELING: VERIFICATION AND APPLICATIONS
James D. Foley, Victor L. Wallace, E. Brownlee, G. Frank, G. Kennedy, D. Mitchell, V. Pashion, J Popelas, J. Thompson, and R. Zarling Griffiss AFB, N. Y. RADC Mar. 1976 196 p refs
(Contract F30602-74-C-0296; AF Proj. 5597)
(AD-A024068; RADC-TR-76-24) Avail: NTIS HC A09/MF A01 CSCL 09/2

This report describes the design, theory of operation, and the testing of a computer program that models and optimizes satellite computer graphics systems. The optimization program answers the following interrelated questions. Given a fixed amount

of money, how should it be allocated among the system components in order to minimize response time? How should the labor be divided between the host and satellite? Data were collected on several real applications and compared to the predicted optimal results. In support of the division of labor problem an initial effort into a device independent language is described. Author (GRA)

N77-11700# Stanford Univ., Calif. Information Systems Lab.
PHOTON LIMITED IMAGES AND THEIR RESTORATION Interim Report, 1 Apr. - 15 Nov. 1975
J. W. Goodman and J. F. Belsher Griffiss AFB, N. Y. RADC Mar. 1976 42 p
(Contract F30602-75-C-0228; ARPA Order 2646; AF Proj. 2646)
(AD-A024027; RADC-TR-76-50) Avail: NTIS HC A03/MF A01 CSCL 09/2

The prime practical limitation encountered in attempts to restore degraded imagery arises from noise inherent in the detected image data. In the first part of this report a model is developed which can be used to mathematically and statistically describe an image detected at low light levels. This model serves to clarify some basic properties of photon noise, and provides a basis for the analysis of image restoration. In the second part the problem of linear least-square restoration of imagery limited by photon noise is considered. The form of the invariant least-square restoration filter is derived using the statistical model appropriate for photon noise. GRA

N77-11701# Harry Diamond Labs., Adelphi, Md.
CRITICAL EQUIPMENT LIST INFORMATION RETRIEVAL
Paul G. Hershall Mar. 1976 59 p refs
(DA Proj. 1W1-62118-AH-75)
(AD-A025070; HDL-TM-76-6) Avail: NTIS HC A04/MF A01 CSCL 09/2

The MOHAWK 2400 terminal has been used to make some selected queries of the Multiple Systems Evaluation Program Critical Equipment List file. Programs were written in MOHAWK data language (MDL). A modular approach was used, with general-purpose subroutines being written to perform distinct list-processing functions. Descriptions and listings of the routines are given. Other MDL techniques of general utility are described. Since the use of the MOHAWK terminal does not entail any extra expense, running data retrieval programs on the MOHAWK 2400 saves funds spent on larger computers, such as the CDC-6600, which are on a use-rate basis. The modular approach, in addition, allows one to write future programs with queries different from the ones that present programs answer, with minimal added effort. GRA

N77-11702# Naval Surface Weapons Center, Dahlgren, Va.
TEKPACK: A UTILITY PACKAGE FOR THE TEKTRONIX 4012 GRAPHICS TERMINAL AND THE UNIVAC 1830A DIGITAL COMPUTER Final Report
William L. Calkins Mar. 1976 32 p
(AD-A025505; NSWC/DL-TR-3442) Avail: NTIS HC A03/MF A01 CSCL 09/2

TEKPACK, a general purpose package of routines for communicating between the Tektronix 4012 graphics terminal and the UNIVAC 1830A digital computer, allows easy input of alphanumeric and graphics data via the 4012 keyboard and cursor thumbwheels, and output of character strings, fixed-point and floating-point numbers, and graphics. Many of the routines are applicable to other ASCII terminals. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N77-11703 Lehigh Univ., Bethlehem, Pa.
COMPUTER CONTROL OF DISTILLATION COLUMN CONTAINING ANALOG OVERRIDES Ph.D. Thesis
Jawahar Khandheria 1976 83 p
Avail: Univ. Microfilms Order No. 76-21816

Several algorithms were experimentally evaluated for preventing reset windup in digital control loops. A new algorithm was developed to handle complex override systems using the error in the secondary controller and the error in the primary controller to detect override conditions and load and set point changes. The method used is a modified freeze algorithm. Dissert. Abstr.

N77-11704 Johns Hopkins Univ., Baltimore, Md.
ITERATED CODES WITH IMPROVED PERFORMANCE Ph.D. Thesis
Alexander Brinton Cooper, III 1976 101 p
Avail: Univ. Microfilms Order No. 76-22913

Using the ratio of channel capacity to information rate, the performance is presented of a generalization of Elias's iterated Hamming single error correcting codes. Linear block codes which correct multiple errors were iterated using a search algorithm to select candidate codes for iteration from a general sub-class of codes. Results obtained for relatively quiet channels are used as foundation for coding and decoding on noisier channels. Comparisons with Elias's original work and with computed improvements to Elias's original results are presented. A new method of constructing and decoding iterated codes is presented. Based upon the properties of shortened codes, this method provides additional improvements to the rates provided by iterated multiple error correcting, linear block codes. Dissert. Abstr.

N77-11705 Illinois Inst. of Tech., Chicago.
FAST SEQUENTIAL DECODING AND A NEW COMPLETE DECODING ALGORITHM Ph.D. Thesis
Pierre Rene Chevillat 1976 181 p
Avail: Univ. Microfilms Order No. 76-23485

The performance of probabilistic algorithms for decoding random error-correcting convolutional codes is investigated and compared using existing random coding results. Sequential decoding, achieves both very low error probabilities and high decoding speeds. However, the Pareto nature of its computational distribution occasionally leads to incomplete decoding, i.e., erasures. In order to minimize the erasure probabilty and maximize decoding speed, a new analysis of the computational effort of sequential decoding is presented. Avoiding any use of random coding arguments, a theorem is proved upper-bounding the computational distribution P(C sub t > N sub t) for a specific time-invariant convolutional code by an exponentially decreasing function of the code's column distance. It is shown that a rapidly increasing column distance function minimizes the erasure probability and maximizes average decoding speed, a result confirmed by computer simulations. Dissert. Abstr.

N77-11706 Arizona State Univ., Tempe.
AN ALGORITHM FOR SYNTHESIS OF COMBINATIONAL LOGIC USING DECOMPOSITION AND PROBABILITY Ph.D. Thesis
Stephen Clark Crist 1976 103 p
Avail: Univ. Microfilms Order No. 76-21837

A new algorithm for the synthesis of single-output, two-valued combinational logic using decomposition and probability is presented. Both completely and incompletely specified functions are considered. Standard forms of decompositions and techniques for their detection and formation are reviewed. Various methods and synthesis, including the probabalistic approach presented therein, are compared. Two probabalistic quantities, the probability of existence of all pertinent decomposition classes and the probable cost of an n variable function with d don't cares, are developed. These quantities are tabulated. A randomly chosen function is assumed. Dissert. Abstr.

N77-11707 California Univ., San Diego.
THE COMPLEXITY OF PARALLEL ALGORITHMS Ph.D. Thesis
Michael Joseph Stimson 1976 218 p
Avail: Univ. Microfilms Order No. 76-23146

The time and storage complexity of parallel algorithms is examined. The storage complexity is studied using a recursive, but non-parallel model of computation - the recursive Turing machine. The measures of complexity are bounds on: (1) the width, (2) the depth of recursion, and (3) the size of the work tape alphabet. Hierarchy theorems are proven for those meas-

ures. Computations of recursive Turing machines are shown to be equivalent to certain tautologous sentences in the propositional calculus. This correspondence is used to produce a specific set, such that if there is any set which distinguishes recursive width complexity classes from non-recursive width complexity classes, then this is one such set. It is also shown that the T(n) time bounded recursive and non-recursive computations are equivalent. Dissert. Abstr.

N77-11708 Johns Hopkins Univ., Baltimore, Md.
A DEMONSTRATION OF THE FEASIBILITY OF USING ENGLISH AS A PROGRAMMING LANGUAGE Ph.D. Thesis
Judith D. Schlesinger 1976 287 p
Avail: Univ. Microfilms Order No. 76-22946

By developing a dictionary, a grammar, and a set of content analysis routines, a programming system (called EPL: English Programming Language) capable of processing procedure-oriented programs, expressed in natural English was developed. The output from EPL is the input program expressed in a formal language called the System Output Language (SOL). The ability to output this code is considered to be adequate demonstration of the ability of the system to correctly process English input. After the grammar has been applied to the input, determining its structure and the identity of input words, action routines are applied, using the dictionary definitions of the words of the sentence. These action routines create the various statements of the system output language, set flags for future use, check for information needed for the various instructions, and in general, create a level of processing which deals with groups of words taken as a whole rather than each word individually.
Dissert. Abstr.

N77-11709 Syracuse Univ., N.Y.
A STUDY OF FAST TRANSFORM ALGORITHMS Ph.D. Thesis
Sun-maw Yang 1975 137 p
Avail Univ. Microfilms Order No. 76-18575

An approach to develop efficient fast Fourier transform (FFT) algorithms for various classes of input, which has length 2n, n > or = 0, is demonstrated, and a class of fast Walsh transform (FWT) algorithms was developed. Also, a useful new definition of Walsh function and some of its applications are developed. Some relations and common properties among fast transform algorithms are also pointed out. A systematic method to analyze fast transform algorithm is developed, and applied to improve fast Fourier transform algorithms for two cases; one is real-valued input, and the other is symmetric real-valued input. Introductions to fast Walsh transform and number-theoretic transform are made by considering a prime factoring algorithm for FFT for its algebraic properties and number-theoretic properties respectively. Dissert. Abstr.

N77-11710 California Univ., Los Angeles.
THE USE OF DYNAMIC ASSERTIONS TO IMPROVE SOFTWARE QUALITY Ph.D. Thesis
Leon George Stucki 1976 186 p
Avail: Univ. Microfilms Order No. 76-22216

An integrated methodology is developed for designing software that can be tested more easily. Emphasis is placed on the definition of meaningful test criteria at each stage of program design. As the design progresses through a series of refinements into a specific programming language, so in turn are the criteria refined and mapped into a corresponding assertion language. This assertion language is embedded in special comments within the host language. These comments can then be used in conjunction with automated programming development tools to enhance the debugging, testing, and certification processes. These dynamic assertion language concepts are developed and demonstrated. A sample methodology for effectively employing these concepts is also presented. A series of experiments was conducted at UCLA to evaluate the value of these techniques.
Dissert. Asbtr.

N77-11711 Syracuse Univ., N.Y.
SOME RESULTS IN MAJORITY DECODING OF BINARY CYCLIC CODES Ph.D. Thesis
Ralph Joseph Longobardi 1975 118 p
Avail: Univ. Microfilms Order No. 76-18536

Nonorthogonal parity check sets for weighted majority decoding of binary cyclic codes are presented. Two methods for construction are given. The first is based on squaring, an automorphism of any binary cyclic code, while the second is based on a measure of reliability. Minimal one-step weighted majority decoders are shown for the (17,9) double-error correcting quadratic residue code and the (15,5) triple-error correcting cyclic Reed-Muller code. A new algorithm for finding the idempotent of any binary cyclic code is given based on the automorphism squaring. Techniques using the idempotent and parity check sets obtained by squaring and shifting are described for reducing the amount of hardware needed for sequential code reduction majority decoding. Dissert. Abstr.

N77-11712 Georgia Inst. of Tech., Atlanta.
LARGE-SCALE PROGRAMMING IN MARKOV DECISION PROCESSES Ph.D. Thesis
Luis Eduardo Contreras Villasenor 1976 208 p
Avail: Univ. Microfilms Order No. 76-22377

Randomly-timed cash flows are adapted to provide the reparameterizations needed to express a semi-Markov decision problem in terms of the equivalent Markov decision problem. In addition to exact procedures, it is shown that sojourn-time distributions may be represented simply by their mean and variance with little error. A state-change modeling procedure is developed and shown to simplify the modeling of the large class of Markov decision problems in which all decisions consist of changes of state. A taxonomy is proposed to unify and compare the various solution algorithms, including new ones developed in this thesis
Dissert. Abstr.

N77-11713 South Carolina Univ., Columbia.
SYSTEM IDENTIFICATION TECHNIQUES USING THE GROUP METHOD OF DATA HANDLING Ph.D. Thesis
Peter Andrew Karnazes 1976 237 p
Avail: Univ. Microfilms Order No. 76-21884

A self-organizing nonlinear mapping algorithm, known as the Group Method of Data Handling (GMDH), is examined. The GMDH algorithm creates a high-dimensional, nonlinear polynomial network that performs an input-output mapping that can be used for system modeling. This modeling methodology is based on the Kilmogorov-Gabor polynomial which has been developed as the most general expression for a nonlinear predictor-filter model. A system must be both state-controllable and state observable before the GMDH input-output model can represent all of the dynamic modes of the system. A procedure is specifically formulated for using GMDH in the area of system identification.
Dissert. Abstr.

N77-11714 Syracuse Univ., N.Y.
SOLUTION OF NETWORKS CONTAINING A TRICHOTOMIZED CLASS OF ELEMENTS Ph.D. Thesis
Caleb A. George 1975 151 p
Avail: Univ. Microfilms Order No. 76-18514

Three types of network elements are considered. These are generalizations of the dependent current generator, the dependent voltage generator, and the inductor. A uniform method of network analysis is presented which can be implemented for the calculation of quiescent, transient, small signal, and periodic solutions. It is based on numerical techniques that use the Jacobian in their calculations, such as Newton's method for calculating the quiescent solution, and Gear's method for calculating transient solutions. A digital computer program named BELAC has been developed which implements the results of this analysis.
Dissert. Abstr.

N77-11715 California Univ., Los Angeles.
COMPUTATIONAL ALGORITHMS FOR CODING BOUND EXPONENTS Ph.D. Thesis
James Richard Lesh 1976 137 p
Avail: Univ. Microfilms Order No. 76-32202

Calculations of random coding bound exponents are hindered by the necessity to optimize over multidimensional input probability distributions. In order to make calculation of these quantities feasible one must have constructive procedures for finding the optimizing distributions. It is observed that the sphere packing bound exponent can be expressed as an appropriately optimized

discrimination function. Proof of this relationship provides insight into the structure of the sphere packing exponent and leads to an efficient algorithm for computing that quality. The algorithm is motivated by the recent works of Arimoto and Blahut and includes their channel capacity algorithm as a special case. The properties of this algorithm are studied and examples of its use are given. Dissert. Abstr.

N77-11716 Polytechnic Inst. of New York.
AUTOMATIC PROGRAM TESTING Ph.D. Thesis
Siba Narayana Mohanty 1976 191 p
Avail: Univ. Microfilms Order No. 76-23436

Automatic means are developed to check software specifications and validate them. Automatic testing focuses on the program analysis, input data selection, development of testing strategy, and measurement of program testedness, all or part of which should be performed by another program or a set of programs. The software is considered as a collection of modules which are either segments or nodes, nodes being the decision points. A complexity measure is associated with any module which is a function of the probability of successful execution of the module. The logical occurrence of the module in the program is used to arrive at an accessibility measure which reflects the ease of accessing any module in the program. Dissert. Abstr.

N77-11717*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RM2: rms ERROR COMPARISONS
R. F. Rice 15 Sep. 1976 12 p refs
(Contract NAS7-100)
(NASA-CR-149150; JPL-TM-33-804) Avail: NTIS HC A02/MF A01 CSCL 09B

The root-mean-square error performance measure is used to compare the relative performance of several widely known source coding algorithms with the RM2 image data compression system. The results demonstrate that RM2 has a uniformly significant performance advantage. Author

N77-11718*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CENTROID AND MOMENTS OF AN AREA USING A DIGITIZER
R. W. Patch Oct. 1976 19 p refs
(NASA-TM-X-73528; E-8947) Avail: NTIS HC A02/MF A01 CSCL 09B

The centroid and moments of an area program provides the centroid, moments of inertia, product of inertia, radii of gyration, and area of any closed planar geometric figure. The figure must be available in graphic form and is digitized once with chart digitizer (graphic tablet). The digitizer origin may be set anywhere on the digitizer table. After digitizing, fifteen quantities are calculated and displayed: (1) area, (2) moment of inertia of area with respect to digitizer x-axis, (3) moment of inertia of area with respect to digitizer y-axis, (4) product of inertia of area with respect to digitizer axes, (5) first moment of x for digitizer axes, (6) first moment of y for digitizer axes, (7) x-coordinate of centroid, (8) y-coordinate of centroid, (9) moment of area inertia of with respect to x-axis through centroid, (10) moment of inertia of area with respect to y-axis through centroid, (11) product inertia of area with respect to x and y-axes through centroid, (12) polar moment of inertia of area around centroid, (13) radius of gyration about digitizer x-axis, (14) radius of gyration about digitizer y-axis; and (15) variance in the x-direction. Author

N77-11719# Argonne National Lab., Ill.
MATCH PACKAGE FOR THE ANL THREE-VIEW GEOMETRY PROGRAM
G. F. Gieraltowski Feb. 1976 80 p refs Sponsored by ERDA
(ANL/HEP/PR-76-11) Avail: NTIS HC A05/MF A01

The ANL MATCH package consists of a set of 13 subroutines which are linked to the current 12-foot and 15-foot versions of the ANL TVGP program. The tracks from the various measured views were matched to obtain a proper matched set of tracks to be processed by TVGP. The MATCH package can effectively handle up to 20 tracks per event measured in 2 or 3 views and, in cases of ambiguous match solutions, allow up to 10 match ambiguities. A basic assumption made is that the same number of tracks is measured in each view. MATCH can work in either two or three measured views with the assumption that, if only two views are measured, the last point measured on each track is a good representation of the true end-point of the track. The probability of obtaining a match solution is inversely proportional both to the number of tracks per vertex and to the momentum of the tracks. (ERA)

N77-11720# Oak Ridge National Lab., Tenn.
ADINDEX: A PL/1 PROGRAM THAT PRODUCES SIMPLE OR STRUCTURED INDEXES FROM ADSEP DATA BASES
F. D. Hammerling and J. L. McNeany Apr. 1976 40 p refs
(Contract W-7405-eng-26)
(ORNL-CSD-TM-1) Avail: NTIS HC A03/MF A01

ADINDEX is a PL/1 program that produces simple or up-to-three-level structured indexes on any combination of fields from ADSEP data bases in a multiple column format, defined by input parameters, suitable for publication with bibliographies. The program will also produce a term frequency count, i.e., a list of terms and the number of times they occur in the data base. This program forms part of the ORCHIS Information System. ERA

N77-11721# Sandia Labs., Albuquerque, N.Mex.
BRIEF INSTRUCTIONS FOR USING MATHLIB (VERSION 6.0)
R. E. Jones and B. B. Bailey Feb. 1976 169 p refs
(Contract AT(29-1)-789)
(SAND-75-0545) Avail: NTIS HC A08/MF A01

The Sandia Numerical Mathematical Subroutine Library (MATHLIB) consists of a number of dependable, high-quality, general-purpose mathematical computing routines. A brief description of how to select and use each routine in the current library (version 6.0) on the CDC 6600 is given. Author (ERA)

N77-11722# California Univ., Livermore. Lawrence Livermore Lab.
STIL: A STATIC TOOL IMPLEMENTATION LANGUAGE
J. C. Huskamp 23 Jan. 1976 59 p refs
(Contract W-7405-eng-48)
(UCID-17014) Avail: NTIS HC A04/MF A01

The design specifications for the language (STIL) were developed for the implementation of software analysis tools based on experience in using static software tools to test and evaluate the security of operating systems. STIL permits new software tools to be implemented faster and allows new tools to be built on existing tools. Since the static software tools that can be written in STIL are essentially data base managers, STIL can be used for more general data base manipulation problems.
Author (ERA)

N77-11723# Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
TREND: A PROGRAM USING CUMULATIVE SUM METHODS TO DETECT LONG-TERM TRENDS IN DATA
R. J. Cranston, R. M. Dunbar, and R. G. Jarvis Jan. 1976 21 p ref
(AECL-5262) Avail: ERDA Depository Libraries HC $3.50; Atomic Energy of Can. Ltd., Chalk River $2.00

TREND is a computer program, in FORTRAN, to investigate data for long-term trends that are masked by short-term statistical fluctuations. To do this, it calculates and plots the cumulative sum of deviations from a chosen mean. As a further aid to diagnosis, the procedure can be repeated with a summation of the cumulative sum itself. Author (ERA)

N77-11724# Medical Biological Lab. RVO-TNO, Rijswijk (Netherlands).
MULTI8, THE PDP8 REAL-TIME OPERATING SYSTEM FOR MULTITASKING FOREGROUND- AND TIMESHARING BACKGROUND OPERATION. PART 1: INTRODUCTION TO MULTI8
J. F. Anthoni and E. LopesCardozo (Utrecht Univ.) Aug. 1975 60 p
(MBL-1975-7; TDCK-66739) Avail: NTIS HC A04/MF A01

MULTI8 is a real-time monitor for use on PDP8 type of computers. It was designed for a wide range of applications: from a 4k core-only system to a foreground/background system

with real-time tasks in the foreground and OS8 timesharing in the background. MULTI8 derives its adaptability from its modular design and from the fact that most PDP8 programs run unchanged in the background. As communication between foreground and background can be done with normal input-output instructions, large portions of a real-time application can be written in any suitable high-level language available for the PDP8 computer. The concepts used in MULTI8 are described assuming some familiarity with PDP8 programming and the OS8 operating system. Author (ESA)

N77-11725# Oxford Univ. (England). Engineering Lab.
THE MULTIVARIABLE IDENTIFICATION PACKAGE FOR A PDP-11 COMPUTER: USER GUIDE
Penelope J. Frost 1976 111 p Sponsored in part by Dept. of Trade and Ind.
(OUEL-1142/76) Avail: NTIS HC A06/MF A01

The multivariable identification package described makes use of the DOS/BATCH monitor. It is a suite of related programs that attempts to produce estimates of linear polynomial matrix models or linear transfer function matrix models by fitting experimentally obtained input-output data in an optimal way. Diagnostic programs indicating the validity of the models are included as well as display programs that provide engineering insight into the identification process. ESA

N77-11726# National Bureau of Standards, Washington, D.C. Systems and Software Div.
USE OF SYNTHETIC BENCHMARKS FOR ESTIMATING SERVICE BUREAU PROCESSING CHARGES Final Report
Jul. 1976 50 p refs
(PB-255054/9; NBS-TN-920) Avail: NTIS HC A03/MF A01 CSCL 09B

The development of a new synthetic benchmark technique for estimating batch processing charges at service bureau sites is described. This technique was used to estimate the cost of processing a large batch workload at a number of service bureaus within the same mainframe family. The method was found to be low cost, yet reasonably accurate for a certain class of service bureau charging algorithms. Refinements of this method are suggested which extend its applicability to other algorithms. The procedures used to create and run the benchmark, together with the projection of total workload cost are described. GRA

N77-11727# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
SOME DATA-BASE APPLICATIONS OF CONSTRAINT EXPRESSIONS M.S. Thesis
R. W. Grossman Feb. 1976 160 p refs
(Contracts N00014-75-C-0661; N00014-75-C-0643)
(AD-A024149; TR-158) Avail: NTIS HC A08/MF A01 CSCL 09/2

This report presents a novel network-like representation for information, called 'constraint expressions' (CE). CE makes use of some of the knowledge-representation techniques developed by Artificial Intelligence research. A CE network consists of points (which represent classes of objects) interconnected by constraints (which represent the relationships which are known to hold among the classes). All constraints are defined in terms of six primitive ones. The data in a CE network is accessed by propagating various kinds of labels through it: Each constraint can be viewed as an active process which looks for certain patterns of labels on some of its attached points, and then propagates new labels to other points when such patterns occur. GRA

N77-11728# Harvard Univ., Cambridge, Mass.
RESEARCH ON AUTOMATIC PROGRAMMING Technical Report, 1 Oct. 1973 - 31 Aug. 1975
31 Dec. 1975 25 p refs
(Contract F19628-74-C-0083)
(AD-A024335; ESD-TR-75-364) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report describes the results of the program of research carried out at Harvard University during the period October 1, 1973 through August 31, 1975 utilizing the PDP-10 and various resources on the ARPANET. The results are concerned with enhancement of the ECL Programming System, use of the ARPANET for data storage and transfer, and devising system architectures for higher level languages. Author (GRA)

N77-11729# Old Dominion Systems, Inc., Gaithersburg, Md.
A COMPUTER PROGRAM TO SIMULATE SCENARIO FUNCTIONS Final Report
F. M. Loveless, Jr. Sep. 1975 17 p
(Contract DAAG53-75-F-0918)
(AD-A024484; ETL-0025) Avail: NTIS HC A02/MF A01 CSCL 09/2

The Scenario Function computer program simulates errors due to masking angle errors, multipath errors, foliage penetration errors and signal strength errors on ranging data from a ground station to a satellite. The perturbed data is then reduced by the MININAP program to study the effect of these unmodeled errors on the recovery of various parameters. Author (GRA)

N77-11730# Stanford Research Inst., Menlo Park, Calif.
A VERIFICATION SYSTEM FOR JOVIAL/J3 PROGRAMS (RUGGED PROGRAMMING ENVIRONMENT: RPE/1) Final Report, 24 Sep. 1974 - 23 Oct. 1975
B. Elspas, R. S. Boyer, R. E. Shostak, and J. M. Spitzen Griffiss AFB, N. Y. RADC Mar. 1976 122 p refs
(Contract F30602-75-C-0042; AF Proj. 5581)
(AD-A024395; SRI-3756-1; RADC-TR-76-58) Avail: NTIS HC A06/MF A01

This report describes a verification system for structured JOVIAL/J3 programs that was designed and implemented during the first year of a research and development program aimed ultimately at a 'Rugged Programming Environment' for JOVIAL. The verification system uses Floyd's method of inductive assertions, and includes a syntax transducer, verification condition generator, and a semiautomatic deductive system for proving the verification conditions. Other work performed on the project included the design of an assertion language for the specification of JOVIAL/J3 programs, and the elaboration of a methodology for carrying out hierarchical verification of suitably structured programs. The report contains sample output illustrating the verification of simple J3 programs. GRA

N77-11731# California Inst. of Tech., Pasadena.
PRACTICAL NATURAL LANGUAGE PROCESSING. THE REL SYSTEM AS PROTOTYPE
Frederick B. Thompson and Bozena Henisz Dostert Griffiss AFB, N. Y. RADC Mar. 1976 80 p refs
(Contract F30602-72-C-0249; AF Proj. 4594)
(AD-A024313; RADC-TR-76-77) Avail: NTIS HC A05/MF A01 CSCL 09/2

REL is a prototype data analysis system that allows complex data analysis to be carried out in response to straight-forward statements in technical English. Data input is handled by bulk data input routines that accept data in customary forms from cards or unit record data sets. Once the data base has been built, the researcher can apply the statistical analyses he desired through English queries. Author (GRA)

N77-11732# Syracuse Univ., N.Y.
AN OPTIMAL ALGORITHM FOR TESTING RANDOM ACCESS MEMORIES Final Technical Report, 1 Jul. 1974 - 1 Sep. 1975
J. Knaizuk, Jr. and C. R. P. Hartmann Griffiss AFB, N. Y. RADC Mar. 1976 29 p
(Contract F30602-71-C-0312; AF Proj. 5519)
(AD-A023894; Rept-75-16; RADC-TR-76-79) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report presents an optimum algorithm to detect any single 'stuck-at-1,' 'stuck-at-0' fault and any combination of solid 'stuck-at-1,' 'stuck-at-0' multiple faults in a random access memory using only the n-bit memory address register and m-bit memory buffer register input and output lines. It is shown that this algorithm requires 4 x 2n memory accesses. Author (GRA)

N77-11733# Yale Univ., New Haven, Conn. Dept. of Computer Science.
RESEARCH ON A HIGH LEVEL LANGUAGE APPROACH TO OPERATING SYSTEM DESIGN Final Report
Richard J. Lipton 12 Apr. 1976 144 p refs
(Grant DAHC04-75-G-0037)

(AD-A023866) Avail: NTIS HC A07/MF A01 CSCL 09/2

This is a summary of the work performed on high level languages for operating systems. The work included: (1) a new method of correctness for asynchronous programs, (2) efficient ways to implement asynchronous programs, (3) protection in operating systems, and (4) the efficiency of structural programs.

Author (GRA)

N77-11734# Naval Air Development Center, Warminster, Pa. Dept. of Aero-Electronic Technology.

ANTENNA PREDICTION COMPUTER PROBLEMS Interim Report

Robert D. Hayes 15 Apr. 1976 6 p

(AD-A024552; NADC-75251-20C) Avail: NTIS HC A02/MF A01 CSCL 09/2

The purpose of this report is to identify a magnetic tape which has stored on it two computer programs. These are the Roll Plane and Bent Plate Programs. Author (GRA)

N77-11735# Naval Ship Research and Development Center, Bethesda, Md.

GRAPH INFORMATION RETRIEVAL LANGUAGE: PROGRAMMING MANUAL FOR FORTRAN COMPLEMENT, REVISION 1

Sidney Berkowitz Feb. 1976 59 p refs Supersedes NSRDC-4137

(SR0140301)

(AD-A025292; DTNSRDC-76-0085; NSRDC-4137) Avail: NTIS HC A04/MF A01 CSCL 09/2

GIRL (Graph Information Retrieval Language) is a programming language designed to conveniently manipulate information in graph structures. As such, the language will play a key role in the construction of the organizational schemes found, for example, in information retrieval, pattern recognition problems, linguistic analysis, and process scheduling systems. The language is written to complement an algebraic language, in the sense that GIRL statements are distinguished from the statements of the algebraic language and the statements may be interleaved. The primary advantage of separating symbolic and numeric statements is that the programmer is afforded a linear, one-one-trace of graph operations in the code description. Author (GRA)

N77-11736# Naval Research Lab., Washington, D.C.

COMPUTER PROGRAM FOR CONVERTING VISUAL DISPLAY FROM DEC, GT-44 TO STROMBERG DATAGRAPHI X4020 Final Report

Frank E. Boyd and James M. Hudnall Apr. 1976 28 p

(NRL Proj. R01-87; RF21222404)

(AD-A025081; NRL-MR-3273) Avail: NTIS HC A03/MF A01

A method of obtaining a permanent copy of the display presented on the Digital Equipment Corporation's GT-44 computer system is presented. Transfer is made to the Stromberg Datagraphics, Inc. type S-C 4020 computer recorder. The latter is capable of producing film negatives of the display. Programs to make the conversion and transfer are listed as well as some corollary Boolian functions. Author (GRA)

N77-11737# British Steel Corp., Sheffield (England). Information Services.

AN OPERATING MANUAL FOR COMPUTER STORAGE, ACCESS AND PRESENTATION OF PLANT TRIAL DATA

G. V. Fairhurst Jun. 1976 58 p

(PB-256058/9; GS/TECH/703/1/75/C) Avail: NTIS HC A04/MF A01 CSCL 09B

An operating manual is presented for a package of data handling programs written in Basic Plus to enable storage and presentation of data on the DEC PDP 11/45 computer. The package is primarily geared to handle data output from GSD data loggers. The data presentation programs enable production of computer plots and VDU screen displays. Output formats include user chosen axis ranges and sizes, data smoothing, mean plots of data for several logging runs and superimposed graphical screen displays. Bulk data plotting and storage may be accomplished by the use of a batching technique. (GRA)

N77-11738# Research Inst. of National Defence, Stockholm (Sweden).

THE CLASS CONCEPT IN THE SIMULA PROGRAMMING LANGUAGE

Jacob Palme Aug. 1976 25 p refs

(PB-256045/6; FOA-C-10052-M3(E5)) Avail: NTIS HC A02/MF A01 CSCL 09B

SIMULA is a general purpose high level language comparable in power to PL/1 or ALGOL 68. Good SIMULA systems are available on most large computers. The methods for program and data structuring in SIMULA are described. These are well suited for structured programming and for the production of secure, modular programs. GRA

N77-11739# Mathematics and Computation Lab., Washington, D. C. Time-Sharing Systems Div.

UTILITY PROGRAMS FOR THE UNIVAC 9300 SYSTEM AT THE MCL COMPUTER FACILITY Final Report

Donald E. Grove and Donald L. Newcome Jun. 1976 90 p refs Sponsored by GSA

(PB-255891/4; GSA/FPA/MCL-TM-256) Avail: NTIS HC A05/MF A01 CSCL 09B

The capabilities which are available on the UNIVAC 9300 computer are discussed. In addition to standard utility programs such as card to tape, tape to printer, etc., software was developed to translate 9 track magnetic tape codes, such as EBCDIC and ASCII, to 7 track fieldata and BCD and vice versa. For clarity, the term 'block' should be interpreted as the physical record on magnetic tape, and the term 'record' as the logical record within a block. GRA

N77-11740# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.

SPECIAL CASES OF THE QUADRATIC ASSIGNMENT PROBLEM

Nicos Christofides and M. Gerrard Apr. 1976 23 p refs Sponsored by ONR and Imperial Coll. of Sci. and Tech., London (Engl.)

(AD-A025605; RR-391; WP-69-75-76) Avail: NTIS HC A02/MF A01 CSCL 12/2

By considering the quadratic assignment problem (QAP) as that of minimizing the product of a distance-graph with a flow-graph several special cases of the QAP are investigated. A polynomial-growth algorithm is described for the QAP when the distance and flow-graphs are isomorphic trees. In the case when the graphs are single stars the algorithm becomes the well known rule for multiplying two sequences of numbers. The case of a complete distance-graph and a tree flow-graph becomes the travelling salesman problem when the tree is a Hamiltonian chain and the flows are all unity. A dynamic programming algorithm is presented for the case of the flow-graph being a general tree with arbitrary flows. The very special case of 'narrow' bipartite graphs is also considered. GRA

N77-11741# California Univ., Berkeley. Operations Research Center.

MULTI-PARAMETRIC MATHEMATICAL PROGRAMMING PROBLEMS

David H. Walters Feb. 1976 207 p refs

(Contract N00014-76-C-0134; NR Proj. 047-033)

(AD-A025715; ORC-76-5) Avail: NTIS HC A10/MF A01 CSCL 12/1

The multi-parametric mathematical programming problems analyzed in this research are the Multi-dimensional sensitivity analysis of the (1) costs or right side in a linear program and (2) constant vector in a linear complementarily problem. Mathematical properties of these problems are derived, and algorithms are devised to solve them. GRA

N77-11742# Naval Research Lab., Washington, D.C.

A FORTRAN COMPUTER PROGRAM FOR CALCULATING THE LINEAR PROLATE FUNCTIONS Final Report

A. L. VanBuren 10 May 1976 45 p refs

(NRL Proj. S01-29; RR1310341)

(AD-A025210; NRL-7994) Avail: NTIS HC A03/MF A01 CSCL 09/2

The representation of band-limited and time-limited physical processes is greatly facilitated by the use of the linear prolate functions and eigenvalues. These functions possess the powerful property of orthogonality over both a finite interval and the infinite interval. A computer program called LINPRO has been developed

to numerically evaluate in double-precision arithmetic the linear prolate functions and eigenvalues for a wide range of order and argument. The program is written in universal FORTRAN and should run on any computer that accepts this language. This report first describes the theory of the prolate spheroidal wave functions used in the construction of the linear prolate functions and eigenvalues. Next the principal features of the program LINPRO are discussed. Included are descriptions of the parameter input, allowable parameter ranges, required computer storage, computational procedure, accuracy of the results, computation time, and printed output. Finally a sample output and a computer listing of LINPRO are attached as Appendixes. Author (GRA)

62 COMPUTER SYSTEMS

Includes computer networks.

N77-11743 Pennsylvania Univ., Philadelphia.
MAN, DESIGN, MACHINE: AN INQUIRY INTO PRINCIPLES OF NORMATIVE PLANNING FOR COMPUTER-BASED TECHNICAL SYSTEMS ILLUSTRATED BY A CASE DESIGN OF AN ENTRY, STORAGE AND RETRIEVAL SYSTEM FOR SCIENTIFIC COMMUNICATION AND TECHNOLOGY TRANFER Ph.D. Thesis
Wlodzimierz Michal Sachs 1976 135 p
Avail: Univ. Microfilms Order No. 76-22774

Systems theory and normative planning are discussed. Fundamental properties of an IDEAL instrumental system based on advanced computer technology are examined. The properties that such a system should display, assuming no design constraints other than technological feasibility and operational viability are established. The principal arguments are: (1) that design of instruments should be SOCIO-TECHNICAL rather than technocratic; (2) such instruments should offer as many standard services as possible to their users; and (3) that they should also allow for users to program their own services. Dissert. Abstr.

N77-11744 Polytechnic Inst. of New York.
THE SYSTEMATIC DESIGN OF COMMUNICATIONS LINE CONTROL PROCEDURES Ph.D. Thesis
Edward Joseph Lancevich 1976 100 p
Avail: Univ. Microfilms Order No. 76-23422

A new computational model is presented for the design of line control procedures. The model consists of a finite-state graph, counter-control unit with associated processing functions. To make the model computationally tractable for the description of practical line control procedures, a companion high-level programming language is also developed. The language, called the communications protocol design language (CPDL), is then applied to the description of simplex half-duplex and full-duplex protocols in order to demonstrate its feasibility for describing practical protocols. CPDL programs are given for each case. A simplified design technique is shown to apply in the case of line control procedures involving formatted messages. This technique modularizes the design into a set of blocks called collection modules. Algorithms for use in an automatic design verification system using CPDL as an input language are developed, and implementations of the line control procedures are described and compared. Dissert. Abstr.

N77-11745 Polytechnic Inst. of New York.
OPTIMAL ORDER REDUCTION Ph.D. Thesis
Hiroyuki Kano 1976 136 p
Avail: Univ. Microfilms Order No. 76-23416

A method is described how the reduced system is obtained that is best in that sense among systems of the same order. The central issue of the method develops to be the determination of the global maximum of a rational function in several variables, which may have many local maxima. A major portion of this thesis is in fact devoted to the solution of this problem. The concept of discriminant matrix of polynomial in one variable first is extended to that associated with a polynomial in several variables in what appears to be a novel way. It is then shown that the determination of the global maximum can be formulated as a generalized eigenvalue problem which involves the newly defined discriminant matrix. Dissert. Abstr.

N77-11746# National Aerospace Lab., Amsterdam (Netherlands). Scientific Services Div.
AN HIERARCHIC MULTI-SUPPLIERS COMPUTER NETWORK OF A RESEARCH LABORATORY WITH TWO SETTLEMENTS
W. Loeve 24 Apr. 1975 9 p Presented at CDC-Users Conf. VIM 22/Ecodu 19, Amsterdam, 21-24 Apr. 1975
(NLR-MP-75012-U) Avail: NTIS HC A02/MF A01

The considerations that formed the basis of a long-term plan to realize an optimal computer network for the NLR aerospace laboratory in the Netherlands are discussed. This network deals with the processing of data from experiments, management information, and mathematical models for simulation. Up to now, in the optimization process, the laboratory has switched from a situation in which one central close shop computer center was available in each of two settlements to a situation in which a multi-suppliers hierarchic computer network exists to serve both settlements. Author (ESA)

N77-11747# National Bureau of Standards, Washington, D.C. Computer Systems Engineering Div.
MEASUREMENT OF COMPUTER COMMUNICATION NETWORKS Interim Report
Marshall D. Abrams, Siegfried Treu, and Robert P. Blanc Jul. 1976 98 p refs
(Grant NSF DCR-72-01206-A05)
(PB-255618/1; NBS-TN-908) Avail: NTIS HC A05/MF A01 CSCL 09B

Procurement of computer services from a remote access network by providing a description of the measures, tools, and techniques applicable to the performance measurement of computer communication networks is described. Cost considerations are discussed as a major component of evaluation. Measurement and evaluation methodology are surveyed, including various operational tools and techniques. Some exemplary data are also presented. GRA

N77-11748# Naval Research Lab., Washington, D.C.
RANDOM BIT GENERATOR Final Report
Kenneth A. Chayt Mar. 1976 48 p refs
(NRL Proj. R01-62)
(AD-A024019; NRL-MR-3249) Avail: NTIS HC A03/MF A01 CSCL 09/2

A random bit generator (RBG) has been built by NRL to aid in evaluating digital voice processors in a controlled error environment. The RBG introduces independent, equiprobable bit errors into the digital output of the processor under test. Thumbwheel switches on the RBG allow selection of the desired bit error rate. The random-number generator used in the RBG was comprehensively tested to verify its stochasticity. Author (GRA)

N77-11749# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
PARALLEL MULTITONIC SORTING NETWORKS Interim Report
Tse-yun Feng and Chung-chang Lee Griffiss AFB, N. Y. RADC Mar. 1976 124 p refs
(Contract F30602-74-C-0335; AF Proj. 5581)
(AD-A024392; RADC-TR-76-93) Avail: NTIS HC A06/MF A01 CSCL 09/2

This report is a study of the characteristics of multitonic sequences applied to parallel sorting networks. The main concern is the interconnections among the comparison levels of the sorting networks. A sorting network depends on various sorting algorithms and basic comparison element (BCE) implementation. A BCE is a device which can compare inputs and yields ordered outputs either in ascending order or in descending order. In order to facilitate analysis, the investigation is first confined to each BCE accepting two inputs only. With this restriction, sorting algorithms for parallel processing are described. Next, a new technique of graphic method is introduced, which helps the analysis of characteristics of multitonic sequences with respect to 2-sorters, and leads to the construction of perfect shuffle networks with '0' and '1' operations. Finally, the same technique of graphic method is also applied to construct perfect shuffle networks with BCE's that can accept three inputs. GRA

N77-11750# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
ASSOCIATIVE PROCESSING OF NETWORK FLOW PROBLEMS Interim Report
Tse-yun Feng, I-Ngo Chen, and Yu-Kuo Chen Griffiss AFB, N. Y. RADC Mar. 1976 98 p refs
(Contract F30602-74-C-0335; AF Proj. 5581)
(AD-A024380; TR-75-16; RADC-TR-76-91) Avail: NTIS HC A05/MF A01 CSCL 09/2

Application of the associative processor to the solution of the network flow problem is investigated. The specific class of problems examined is the maximal flow problem. The results of this research support the conclusion that: a best sequential algorithm may not be a good associative algorithm, while a bad sequential algorithm can be the best associative algorithm; the performance of an associative processor will be greatly improved if a data manipulator is added to the processor. GRA

N77-11751# Mitre Corp., Bedford, Mass.
QUEUING ANALYSIS OF AN IBM 370 COMPUTER SYSTEM
K. Streenivasan Apr. 1976 29 p refs
(Contract F19628-76-C-0001; AF Proj. 572C)
(AD-A025270; MTR-3122; ESD-TR-76-139) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes the results of an investigation on the use of a simple, two-server, cyclic queuing model to estimate the performance of the MITRE IBM 370 computer system. Controlled experiments were conducted in a dedicated environment using a batch workload consisting of parameter driven synthetic programs. For a large number of experiments there were significant differences between the calculated and the measured values of the average elapsed time. It is recommended that further analysis and experimental work be undertaken.
Author (GRA)

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N77-11752 New Mexico State Univ., University Park.
SPECULATION ON THE EVOLUTION OF INTELLIGENCE AND ITS POSSIBLE REALIZATION IN MACHINE FORM Ph.D. Thesis
Joe Wirt Atmar, III 1976 203 p
Avail: Univ. Microfilms Order No. 76-22497

Three organizational forms of intelligence are defined: (1) phylogenetic (intelligence arising within the phyletic line of descent), (2) ontogenetic (arising within the individual), and (3) sociogenetic (arising within the group). The three forms of intelligence are argued to be equivalent in process in that each contains a reservoir of learned behavior and a quantum unit of mutability. It is also argued that the ontogenetic and sociogenetic forms of intelligence are phylogenetically-learned behavioral traits and possess great selective advantage to the possessor organisms. Finite-state deterministic automata are used to simulate the evolutionary process in the manner of Fogel, Owens and Walsh (1966). Parallel phylogenies of evolutionary automata are designed to investigate the process of adaptation and those factors which control the rate and degree of learning achieved phylogenetically. A scheme is proposed to use the evolutionary automata in pattern recognition. Self-classification and self-dichotomization methods are presented which allow evolving phylogenies of FSM's to quickly learn to classify pattern strings with no prior description of recognition features to do so. Dissert. Abstr.

N77-11753 Polytechnic Inst. of New York, Farmingdale.
ROBUST STATISTICAL TECHNIQUES IN PATTERN RECOGNITION: GRAY-LEVEL AND EDGE DETECTION Ph.D. Thesis
Panagiotis I. Legakis 1976 196 p
Avail: Univ. Microfilms Order No. 76-23427

Robust statistical classification procedures based on distribution-free quantile estimation, are proposed for the solution of the gray level and texture edge detection problems. These procedures cover the full spectrum of signal-to-noise ratios under unknown signal conditions. All the procedures presented take full advantage of the data reduction based on estimated quantiles. Specifically, techniques based on one and two-way analysis of variance based on quantile estimates are applied to the edge detection problem. The quantile estimation procedures yield asymptotically normal estimates regardless of the distribution of the observables. In addition, by properly selecting the quantiles, the much simpler fixed effects model of analysis of variance can be applied to both gray level and texture edge detection. Further, two- and three-sample Mann-Whitney statistics based on quantile occupancy vectors are introduced in the solution of the gray level detection problem. Dissert. Abstr.

N77-11754 Massachusetts Univ., Amherst.
THE STABILIZATION OF BILINEAR SYSTEMS AND ITS APPLICATION TO THE DISCRETE MODEL REFERENCE ADAPTIVE CONTROL Ph.D. Thesis
Tudor Vladimir Ionescu 1976 172 p
Avail: Univ. Microfilms Order No. 76-22265

The following problems are considered: (1) feedback stabilization problem for bilinear systems (both discrete and continuous) with constant quadratic and bang-bang controls; (2) model reference adaptive control problem for discrete single input single output plants without allowing anticipatory values of the plant output in the design scheme; and (3) finally using (1) and (2), the implementation of a particular class of bilinear controllers in the discrete model reference adaptive bilinear plants is studied. Sufficient conditions for the existence of stabilizing constant controls for several classes of continuous bilinear systems are given. It is also shown that the set U from which such controls can be selected, is convex and open. A computational procedure that allows a complete determination of U using only the eigenvalues and the eigen-vectors of the system's matrices is also developed. The method is easily applicable in any higher dimensional problems by using well known, standard numerical procedures for the determination of the eigenvectors and eigenvalues of constant matrices. Dissert. Abstr.

N77-11755*# California Univ., Los Angeles. School of Engineering and Applied Science.
CONTROL BY MODEL ERROR ESTIMATION
Peter W. Likins and Robert Eugene Skelton Mar. 1976 231 p refs
(Contract NAS8-28358)
(NASA-CR-150059; UCLA-ENG-7630) Avail: NTIS HC A11/MF A01 CSCL 12B

Modern control theory relies upon the fidelity of the mathematical model of the system. Truncated modes, external disturbances, and parameter errors in linear system models are corrected by augmenting to the original system of equations an 'error system' which is designed to approximate the effects of such model errors. A Chebyshev error system is developed for application to the Large Space Telescope (LST). Author

N77-11756# Oxford Univ. (England). Engineering Lab.
FREQUENCY DOMAIN SOLUTION OF THE OPTIMUM STEADY-STATE REGULATOR PROBLEM
P. J. Gawthrop 1976 33 p refs
(OUEL-1145/76) Avail: NTIS HC A03/MF A01

A method for the design of steady state regulators for single input, single output stochastic systems to minimize a quadratic performance criterion is presented. The systems considered are disturbed by, and have output measurements corrupted by, stochastic processes with rational spectral density, may have poles and zeros outside the stability region, and contain a pure time delay. The design procedure is independent of the non-minimum phase characteristics of the system. A complete derivation is given for continuous systems, and the solution to the discrete problem outlined. Examples are given to illustrate the method. Author (ESA)

N77-11757# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
COVARIANCE-INVARIANT DISCRETE-TIME SYSTEMS
Joseph Perl and Louis L. Scharf 8 Apr. 1976 44 p refs
(Contract N00014-75-C-0518)

(AD-A024273; TR-16) Avail: NTIS HC A03/MF A01 CSCL 12/1

The problems of minimal realization and spectral factorization are reviewed in a tutorial manner and a new, indirect method for solving these problems is presented. The method is based on a covariance-invariance between continuous-time and discrete-time systems. Applications in Kalman filtering, digital filtering and process simulation are discussed. GRA

N77-11758# Navy Personnel Research and Development Center, San Diego, Calif.

ADAPTIVE COMPUTER-ASSISTED TUTORIALS: A CYBERNETIC APPROACH OPTIMIZATION WITH FINITE-STATE MACHINES Technical Report, Mar. 1974 - Jan. 1975

Joseph Offir Mar. 1976 64 p refs Sponsored by ARPA (RF55522002)

(AD-A024252; NPRDC-TR-76-33) Avail: NTIS HC A04/MF A01 CSCL 09/2

The report outlines a formal approach to computer-based adaptive tutorial systems. A description is provided of the components that such a system must have in order to improve dynamically the performance of an individual trainee, with respect to prechosen criteria, in a sequential process of formal problem solving. GRA

N77-11759# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.

KNOWLEDGE ACQUISITION FROM STRUCTURAL DESCRIPTIONS

Frederick Hayes-Roth and John McDermott Feb. 1976 41 p refs

(Contract F44620-73-C-0074; ARPA Order 2466)

(AD-A025074; AFOSR-76-0602TR) Avail: NTIS HC A03/MF A01 CSCL 06/4

The representation of concepts and antecedent-consequent productions is discussed, and a method for inducing knowledge by abstracting such representations from a sequence of training examples is described. The proposed learning method, interference matching, induces abstractions by finding relational properties common to two or more exemplars. Three tasks solved by a program which performs an interference matching algorithm are presented. Several problems concerning the relational representation of examples and the induction of knowledge by interference matching are also discussed. Author (GRA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N77-11760 Lehigh Univ., Bethlehem, Pa.

ON ESTIMATION OF REGRESSION COEFFICIENTS Ph.D. Thesis

Carlos David Vinante 1976 71 p

Avail: Univ. Microfilms Order No. 76-21834

The asymptotic form of the variance of the best linear unbiased estimator for the regression coefficient can be expressed in terms of the spectrum of the regression function and its derivatives. When theta(t,T) is a homogeneous polynomial in t and T, for a large class of spectral densities, the best linear unbiased estimator is seen to depend only on the behavior of the spectral density near the origin. Asymptotically efficient estimators based only on this behavior may be chosen. For theta(t,T) = 1 and spectral densities behaving like lambda(2 neutrino) at the origin, neutrino greater than -1 an integer, the minimum variance decreases like T(2 neutrino + 1). Asymptotically efficient estimators depending on neutrino are given. The consequences of over- or under-estimating the value of neutrino in choosing an estimator are also considered. Finally the relation between estimation of the mean of a stationary process and data smoothing is considered and asymptotically optimum weighting functions for the smoothing filters are found. For input noise with spectral density behaving like lambda(2 neutrino) at the origin, the variance of the output of the optimum filter decreases like T(2 neutrino + 1) and asymptotically optimum weighting functions depending on neutrino are found. Dissert. Abstr.

N77-11761 California Univ., Los Angeles.

APPROXIMATION AND INTERPOLATION BY INNER FUNCTIONS Ph.D. Thesis

Donald Eddy Marshall 1976 47 p

Avail: Univ. Microfilms Order No. 76-22205

Let H(infinity) be the Banach algebra of bounded analytic functions on the open unit disc in the complex plane. It is assumed that u eta H(infinity) is an inner function if u has unimodular boundary values. Three uniform approximation theorems involving inner functions are proved. Each of these theorems depends on an interpolation theorem involving inner functions. An elementary constructive proof is given of an interpolation theorem of Pick, and how this theorem yields a theorem of Fisher on uniform approximation by convex combinations of finite Blaschke products is shown. An interpolation theorem of Nevanlinna, among other results, is used to prove that inner functions generate H(infinity). Finally, a theroem of Carleson about interpolation sequences and a result of S.-Y. Chang are used to prove a conjecture of R. Douglas about algebras between H(infinity) and L(infinity). Dissert. Abstr.

N77-11762 Polytechnic Inst. of New York.

FINITE STATE EQUALIZATION Ph.D. Thesis

Howard Clarence Meadors, Jr. 1976 150 p

Avail: Univ. Microfilms Order No. 76-23433

The bit by bit detection is considered of the members of a binary data sequence based on samples subject to intersymbol interference and Gaussian noise. The machine under consideration operates simultaneously on the most recently received sample and a stored representation of information derived from past samples to make the decision. The performance and structure of the system are examined when the memory avaiable is limited so as to be inadequate to precisely represent a substantial number of past samples or sequence probabilities conditioned on past samples. Several simple examples are considered to show the advantages which can be obtained by the proper processing of data when memory restrictions are imposed. Through the judicious use of approximations, a structure is developed in which the memory states resemble progressive estimates of the undecided symbols. Computer simulations of performance are given.

Dissert. Abstr.

N77-11763*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

INTEGRATION-FREE INTERVAL DOUBLING FOR RICCATI EQUATION SOLUTIONS

Gerald J. Bierman and Gursharan S. Sidhu (State Univ. of New York, Buffalo) 1 Oct. 1976 22 p refs

(Contract NAS7-100)

(NASA-CR-149145; JPL-TM-33-799) Avail: NTIS HC A02/MF A01 CSCL 12A

Various algorithms are given for the case of constant coefficients. The algorithms are based on two ideas: first, relate the Re solution with general initial conditions to anchored RE solutions; and second, when the coefficients are constant the anchored solutions have a basic shift-invariance property. These ideas are used to construct an integration free superlinearly convergent iterative solution to the algebraic RE. The algorithm, arranged in square-root form, is thought to be numerically stable and competitive with other methods of solving the algebraic RE. Author

N77-11764# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.

FINITE-DIFFERENCE APPROXIMATIONS AND ENTROPY CONDITIONS FOR SHOCKS

A. Harten, J. M. Hyman, P. D. Lax, and B. Keyfitz Jan. 1976 48 p refs

(Contract E(11-1)-3077)

(COO-3077-106; IMM-411) Avail: NTIS HC A03/MF A01

Weak solutions of hyperbolic conservation laws are not uniquely determined by their initial values; an entropy condition is needed to pick out the physically relevant solution. The question arises whether finite difference approximations coverge to this particular solution. It is shown that in the case of a single conservation law, monotone schemes, when convergent, always

converge to the physically relevant solution. Numerical examples show that this is not always the case with nonmonotone schemes, such as the Lax-Wendroff scheme. Author (ERA)

N77-11765# Oak Ridge National Lab., Tenn.
EXPLICIT INVERSES OF SOME SPECIAL MATRICES (WITH A FEW COMPUTER PROGRAMS)
V. R. R. Uppuluri and B. L. Kirk Feb. 1976 59 p refs
(Contract W-7405-eng-26)
(ORNL-CSD-2) Avail: NTIS HC A04/MF A01

Explicit inverses of some classes of special matrices are presented. The tridiagonal matrices are discussed. An algorithm due to Sherman and Morrison, which is useful in finding the inverse, when an explicit inverse is known for an unperturbed matrix, is given. Inverses of some patterned matrices, and computer programs of some of the problems discussed, are also included. Author (ERA)

N77-11766# Texas Univ., Austin. Inst. for Computational Mechanics.
MIXED-HYBRID FINITE ELEMENT APPROXIMATIONS OF SECOND-ORDER ELLIPTIC BOUNDARY-VALUE PROBLEMS Interim Report
I. Babuska, J. T. Oden, and J. K. Lee Dec. 1975 45 p refs
(Contract AT(40-1)-3443)
(ORO-3443-59; AFOSR-75-1704TR) Avail: NTIS HC A03/MF A01

Mixed hybrid finite element approximations are described for second order elliptic boundary value problems in which independent approximations are used for the solution and its gradient on the interior of an element and the trace of the gradients on the boundary of the element. This leads to nonconforming finite elements. The independent boundary approximations are introduced by means of Lagrange multipliers. Error estimates are derived a priori. Several other finite element models are also obtained as special cases. Author (ERA)

N77-11767# California Univ., Livermore. Lawrence Livermore Lab.
PIECEWISE POLYNOMIAL FUNCTIONS
R. E. Carlson Jan. 1976 46 p refs
(Contract W-7405-eng-48)
(UCID-17059) Avail: NTIS HC A03/MF A01

A series of talks presented during the summer of 1975 at LLL on the general topic of piecewise polynomial functions is reported. Such functions offer simple, accurate, economical, and flexible procedures for solving a wide variety of problems. The emphasis is on curve fitting, surface fitting, and applications to finite element approximations. Attention is directed to the basic of cubic (and bicubic) interpolation and approximation, since they represent a good first choice for many problems when increased accuracy over linear (or bilinear) approximations is desired. The text is divided into sections on univariate functions, cubic splines, bivariate functions, blending functions, and nonrectangular bivariate functions, blending functions, and nonrectangular domains. ERA

N77-11768# Missouri Univ., Columbia. Dept. of Statistics.
SOME ITERATIVE PROCEDURES TO OBTAIN NONLINEAR LEAST SQUARES ESTIMATES Interim Report
R. P. Kelley 1 Apr. 1976 17 p refs
(Contract N00014-75-C-0443; NR Proj. 042-282)
(AD-A024437; TR-58; Rept-76-3) Avail: NTIS HC A02/MF A01 CSCL 12/1

This review paper discusses the basic theory and underlying motivation, the algorithm, and the problems of convergence for some of the common techniques now in use to obtain nonlinear, least squares, estimates. The methods considered are the method of steepest descent, the Newton-Raphson method, the Gauss-Newton method, Hartley's modified Gauss-Newton method, and Marquardt's method. Special attention is paid to Marquardt's method. GRA

N77-11769# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
TIME SERIES ANALYSIS APPLIED TO DATA FROM A SINGLE OCEAN WAVE GAUGE
Allan W. Bjerkaas Feb. 1976 194 p refs
(Contract N00017-72-C-4401)
(AD-A023821; APL/JHU-POR-3117) Avail: NTIS HC A09/MF A01 CSCL 12/1

A method has been developed to analyze the time record of the sea surface elevation that is obtained from a single wave gauge at a fixed location. The method includes the calculation of sea surface amplitude and wave height probability densities, the significant wave height, the zero-crossing wave period, and the elevation power spectral density and autocorrelation function. The ocean wave dispersion relation is used to calculate the sea surface elevation, slope, and curvature power spectral densities as functions of wave number. In addition, the data record is tested for stationariness and normality. It should be noted that this analysis method is applicable to any data in the form of a time series. In the most general case the amplitude probability density, the autocorrelation function, and the power spectral density of any time series may be calculated. Particular mathematical techniques were used to implement this analysis method, and a modular PL/1 computer program was written to execute these techniques on an IBM 360/91 computer. The use of this computer program is described in the Appendixes. Author (GRA)

N77-11770# Princeton Univ., N.J. Dept. of Statistics.
ON THE LOGARITHMS OF HIGH ORDER SPACINGS
Noel Cressie Oct. 1975 32 p refs Sponsored in part by the Western Australia Univ.
(Contract N00014-75-C-0453)
(AD-A023716; TR-97-Ser-2) Avail: NTIS HC A03/MF A01 CSCL 12/1

The sum of the logarithms of the gaps between order statistics of order m+n and n for N=0 to N+l-m is studied as a test for uniformity on the unit interval, given a sample of size N. Exact means and variances and asymptotic normality are shown in the null case for this problem and that on the circle. Power studies of the test for local alternatives show that the Pitman efficiency is proportional to m. Author

N77-11771# Tel-Aviv Univ. (Israel). Dept. of Mathematical Sciences.
MULTIDIMENSIONAL DIFFERENCE SCHEMES WITH FOURTH ORDER ACCURACY Interim Report
E. Turkel, S. Abarbanel, and D. Gottlieb Nov. 1975 53 p refs
(Contract F44620-71-C-0110; Grant AF-AFOSR-2370-72; AF Proj. 9781)
(AD-A023766; AFOSR-76-0189TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

An explicit finite difference algorithm for the solution of quasi-linear divergence free multidimensional hyperbolic systems is described. The method consists of four steps per time level. The resulting scheme is fourth order accurate in both space and time though the intermediate steps are only first order accurate. The family of schemes introduced is dissipative and hence suitable for both smooth flows and flows containing shocks. This method is compared, in several numerical examples, with both second order schemes and others that are fourth order in space but second order in time. Author (GRA)

N77-11772# Washington State Univ., Pullman.
NUMERICAL SOLUTION OF TWO-DIMENSIONAL INTEGRAL EQUATIONS USING LINEAR ELEMENTS Technical Report, 1973 - 1976
Richard J. Hanson and James L. Phillips 6 Feb. 1976 34 p refs
(Contract N00014-68-A-0410-0004; NR Proj. 044-457)
(AD-A023693; CS-76-026) Avail: NTIS HC A03/MF A01 CSCL 12/1

A general procedure is presented for numerically solving linear Fredholm integral equations of the first kind in two integration variables. The approximate solution is expressed as piecewise bilinear or linear functions on rectangles or triangles, respectively. The method involves collocation followed by the solution of an appropriately scaled stabilized matrix least squares problem. The stabilizing procedure consists of appending additional equations to the system that resulted from collocation. These additional equations arise from considering an appropriately weighted seminorm on the unknown solution. These numerical examples are given. Author (GRA)

N77-11773# Wisconsin Univ., Madison. Dept. of Statistics.
A CANONICAL ANALYSIS OF MULTIPLE TIME SERIES Interim Technical Report
G. E. P. Box and G. C. Tiao Nov. 1975 33 p refs
(Grant DAHC04-76-G-0010)
(AD-A023861; UWIS-DS-75-428) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper proposes a canonical transformation of a k dimensional stationary autoregressive process. The components of the transformed process are ordered from least predictable to most predictable. The least predictable components are often nearly white noise and the most predictable can be nearly nonstationary. Transformed variables which are white noise can reflect relationships which may be associated with or point to economic or physical laws. A 5-variate example is given. GRA

N77-11774# Florida Univ., Gainesville. Center for Mathematical Theory.
ON DISCRETE-TIME POLYNOMIAL SYSTEMS Interim Report
Eduardo D. Sontag and Yves Rouchalean 1975 15 p refs
(Grants AF-AFOSR-2268-72; DAHC04-74-G-0153; AF Proj. 9769)
(AD-A024481; AFOSR-76-0454TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Algebraic geometry is the natural tool for the study of a broad class of discrete-time nonlinear systems. This class consists of those systems described by polynomial transitions and polynomial constraints in the state set. The examples of nonlinear systems whose structure theory is today at all understood (bilinear input/output, bilinear in the state) are instances of this broad class of systems. In the present paper we show that a number of finiteness results can be derived for systems via the application of standard methods in algebraic geometry. In particular, we obtain practical tests for equality of behaviors, reachability and observability. Finally, we prove a preliminary result which gives conditions under which two systems with same input/output behavior are isomorphic. Author (GRA)

N77-11775# Air Force Geophysics Lab., Hanscom AFB, Mass.
A SHOOTING METHOD FOR THE SOLUTION OF A DISCRETE POISSON EQUATION ON THE SURFACE OF A SPHERE Environmental Research Papers
Samuel Y. K. Yee 20 Feb. 1976 21 p refs
(AF Proj. 8604)
(AD-A024158; AFGL-TR-76-0035; AFGL-ERP-552) Avail: NTIS HC A02/MF A01 CSCL 12/1

The solution of the Poisson equation plays an important role in problems such as air pollution and numerical weather prediction in geophysics and in problems such as fission in reactor physics. In the case of numerical weather prediction where solutions to the Poisson equation are required in daily routine operations, it is paramount that the solution procedure be efficient. An efficient shooting method is presented for the numerical solution of a discrete Poisson equation on the surface of the sphere. The solution is computed via two-dimensional shooting in the physical domain while the 'missing initial conditions' needed to start the shooting are obtained in a one-dimensional setting in the Fourier domain. GRA

N77-11776# Denver Research Inst., Colo. Div. of Mathematical Sciences.
INVERSE SOURCE PROBLEM: EIGENFUNCTION ANALYSIS OF BOJARSKI'S INTEGRAL EQUATION
Jack K. Cohen and Norman Bleistein 25 Apr. 1976 22 p refs
(Contracts N00014-76-C-0079; N00014-76-C-0039; NR Proj. 041-434; NR Proj. 083-364)
(AD-A025297; MS-R-7616) Avail: NTIS HC A02/MF A01 CSCL 12/1

An integral equation elsewhere employed to solve inverse source problems is discussed from the viewpoint of Hilbert Space theory. The eigenfunctions and eigenvalues are determined and the null space is explicitly shown to be infinite dimensional. An existence criterion is established and application is made to the problem of determining sources which radiate maximum power for given input power. Author (GRA)

N77-11777# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
EFFICIENT SOLUTIONS IN MULTIOBJECTIVE TREE NETWORK LOCATION PROBLEMS
Timothy J. Lowe Mar. 1976 25 p refs
(Contract DAHC04-75-G-0150; Grant NSF ENG-75-10225; DA Proj. 200-61102-A-14D)
(AD-A025289; RR-76-3; ARO-12640.4-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

Much of the literature involving locating one or more new facilities on a network is concerned with minimizing a single objective function subject to constraints on the location variable. In this paper, we consider the problem of locating a single facility on a tree network where there is more than one objective function to be minimized. A constructive method is given for finding the efficient set of solutions when the objective functions are convex and the constraints define a convex set. In addition, an example problem is provided. We also consider the case where the feasible region is not a convex set. Author (GRA)

N77-11778# Stanford Univ., Palo Alto, Calif. Instrumentation Research Lab.
PARTIALLY OBSERVABLE MARKOV DECISION PROCESSES OVER AN INFINITE PLANNING HORIZON WITH DISCOUNTING Technical Report, 1 Jan. - 31 Mar. 1976
Richard D. Wollmer Mar. 1976 35 p refs
(Contract N00014-75-C-0838; ARPA Order 2284; RR0420601)
(AD-A025077; TR-77) Avail: NTIS HC A03/MF A01 CSCL 12/1

This is the last in a series of technical reports concerned with mathematical approaches to instructional sequence optimization in instructional systems. This paper deals with Markov decision processes where the true state of the system is not known with certainty. Hence the state of the system is characterized by a probability vector. Each action yields an expected reward, transforms the system to a new state and yields an observable outcome. One wishes to determine an action for each probability state vector so as to maximize the total expected reward. This report treats the infinite time horizon with a discount factor, using a partial N dimensional Maclaurin series to approximate the total optimal reward as a function of the probability state vector. GRA

N77-11779# Army Material Systems Analysis Activity, Aberdeen Proving Ground, Md.
NECESSARY CONDITIONS FOR THE EXISTENCE OF SOME INCOMPLETE BLOCK DESIGNS
Alan W. Benton May 1976 24 p refs
(DA Proj. 1R7-65706-M-541)
(AD-A025856; AMSAA-TR-162) Avail: NTIS HC A02/MF A01 CSCL 12/1

A development of nonexistence proofs of certain balanced incomplete block designs is presented which leads to simplifications of some of the necessary conditions for symmetrical balanced incomplete block designs (SBIBD). The unified approach of using properties of the integer matrices in determining necessary conditions for SBIBDs has been extended to intra- and inter-group balanced incomplete block designs which were defined by Nair and Bose. Author (GRA)

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N77-11780 Polytechnic Inst. of New York.
PROBABILITY MEASURES ON ALGEBRAS Ph.D. Thesis
William Allen Josephson 1976 80 p
Avail: Univ. Microfilms Order No. 76-23413

Finitely additive, bounded measures are studied on subalgebras of a completely distributive Boolean algebra. Specifically, the algebras are generated by lattices, and the most important measures are lattice regular. Dissert. Abstr.

N77-11781 Polytechnic Inst. of New York.
SEQUENTIAL PARTITION DETECTORS WITH APPLICATIONS Ph.D. Thesis
Roger Francis Dwyer 1976 208 p
Avail: Univ. Microfilms Order No. 76-23404

The theory of nonparametric partition detectors to include sequential operation and dependent sampling is presented. In particular, the problem of sequentially testing the hypothesis, H0, against a composite alternative, H1, when the functional form of the underlying noise distribution is unknown, is considered. To that end, the observation space in R1 is partitioned into m intervals based on knowledge of only a finite number of quantiles of the noise distribution. Specifically, a partitioning based on quantiles of the noise eliminates the need to know the form of the distributions under the alternative. The ease of implementation and robustness of the m-interval detectors make the sequential partition detectors (Spd) based on m-interval partitioning particularly attractive. Dissert. Abstr.

N77-11782 Johns Hopkins Univ., Baltimore, Md.
THE APPLICATION OF DOUBLY STOCHASTIC POISSON PROCESS ESTIMATION TECHNIQUES TO OPTICAL COMMUNICATION THROUGH LOG-NORMAL FADING CHANNELS Ph.D. Thesis
John Gerard Romanski 1976 195 p
Avail: Univ. Microfilms Order No. 76-22944

Recent theoretical studies have led to mathematical characterizations of optimal direct detection optical communication receiver structures. The performance of these receivers cannot be mathematically predicted due to the complexity and stochastic nature of the equations which define them. The performance of both the optimal and suboptimal theoretical receiver structures was experimentally measured for the case of on-off signalling with laser light subjected to log normal fading. The receiver structure consisted of two parts: first a causal estimate of the received optical field intensity was formed based on the recorded photon absorption times; second, the estimate was incorporated into a likelihood ratio test for doubly stochastic Poisson processes and a decision made as to whether a digital one or zero was received based on the final value of the likelihood ratio.
Dissert. Abstr.

N77-11783 Georgia Inst. of Tech., Atlanta.
ITERATIVE FORWARD-ADJOINT MONTE CARLO SOLUTIONS OF THE BOLTZMANN TRANSPORT EQUATION Ph.D. Thesis
Noel Rickey Byrn 1976 255 p
Avail: Univ. Microfilms Order No. 76-22374

A Monte Carlo importance sampling variance reduction technique was developed for application to complex radiation transport problems. The technique is based on iterative solutions of the forward and adjoint integral transport equations. Importance functions are generated for altering the natural sampling distributions in the forward Monte Carlo simulation from the adjoint flux estimated during the adjoint case. Likewise, the flux estimated during the forward case is used to generate importance functions for altering the adjoint Monte Carlo sampling distributions. The altered distributions are the source energy and direction, the transport kernel and the collision kernel. By iteratively solving the forward and adjoint transport equations, better importance functions are generated which improve the efficiency of the Monte Carlo simulation at successive steps. Dissert. Abstr.

N77-11784 California Univ., Los Angeles.
STOCHASTIC MULTISTAGE LINEAR DIFFERENTIAL GAME WITH DECISION-TIME CONSTRAINTS Ph.D. Thesis
Colin Kui-pan Lau 1976 189 p
Avail: Univ. Microfilms Order No. 76-22200

A class of multistage stochastic linear differential game with quadratic cost function subject to decision-time constraints is considered. Two formulations are set up: first, the post initial measurement decision formulation; and second, the post measurement decision renewal formulation. Secure strategies, in the sense of minimax and maximin, are derived for each player by applying dynamic programming. The results for the second formulation not only dictate what each player's current optimal control sould be, but also explicitly project his future optimal moves using current information only. The results for the first formulation do not possess this property. Furthermore, the results for the first formulation imply the availability of measurement data at each stage of the game. However, the allowance for data dropout at any stage is built in the optimal strategies of the second formulation. Dissert. Abstr.

N77-11785*# Transemantics, Inc., Washington, D.C.
CONDITIONALLY EFFECTIVE EVALUATIONS OF THE PARAMETERS OF NONLINEAR MODELS
L. S. Gurin and K. A. Tsoy NASA Oct. 1976 37 p refs Transl. into ENGLISH of "Uslovno-Effektivnyye Otsenki Parametrov Nelineynykh Modeley" rept. Pr-257, Inst. of Space Res., Acad. Sci. USSR, Moscow, 1975 p 1-33
(Contract NASw-2792)
(NASA-TT-F-17264; PR-257) Avail: NTIS HC A03/MF A01 CSCL 12A

During model parameter estimation of physical phenomena based on statistical processing, a significant role is played by realization time of the algorithm for obtaining estimates on the computer. The necessity has arisen for introducing conditional effective estimates which have the best accuracy with assigned limitations on the time-consuming aspect of the algorithm. Various approaches to obtaining parameter estimates of nonlinear models are examined. Methods of multiextremum and global optimization are used for solving the set problems. Author

N77-11786*# Transemantics, Inc., Washington, D.C.
APPLICATION OF THE MAXIMUM PLAUSIBILITY METHOD TO THE PROBLEM OF DETERMINATION OF THE INTENSITIES OF AN INTERMIXED POISSON FLUX
K. A. Tsoy NASA Oct. 1976 17 p refs Transl. into ENGLISH from the Russian report Pr-256
(Contract NASw-2792)
(NASA-TT-F-17265; Pr-256) Avail: NTIS HC A02/MF A01 CSCL 12A

A sequence of time marks is obtained on a summation meter which records four particle fluxes of different intensities. Each flux is isolated by a corresponding filter, and each eighth particle is recorded. The method of maximum plausibility is applied to the problem of estimating the unknown intensities. A method is presented for finding the global extremum of a function of many variables, which is then used to find the maximum of the logarithm of the plausibility function. A comparative table is included.
Author

N77-11787# California Univ., Berkeley. Statistical Lab.
MATHEMATICAL STATISTICS AND PROBABILITY: STOCHASTIC PROCESSES Final Report, 10 Aug. 1972 - 30 Nov. 1975
Lucien Le Cam 1 Apr. 1976 12 p refs
(Contract DA-ARO(D)-31-124-73-G31)
(AD-A024082; ARO-10913.14-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

This report gives a brief summary of research findings in several areas including: General theory of clustering for point processes; Speed of convergence for multidimensional central limit theorems; Sequential experiments with power unity; Existence of estimates which converge at the maximum possible speed; Comparison of translation experiments; Functional Central limit theorems; Mixtures of Poisson distributions; Estimates of survival probabilities in censored models; and History of Statistics in the United States. GRA

N77-11788# Kentucky Univ., Lexington. Dept. of Statistics.
A NOTE ON DISTRIBUTION-FREE TOLERANCE LIMITS
Z. Govindarajulu Feb. 1976 16 p refs
(Contract N00014-75-C-1003; NR Proj. 042-295)
(AD-A024137; TR-97; TR-14-ONR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Solutions based on a normal approximation to the incomplete beta function are obtained for one of the parameters in terms of the others in order to set up distribution-free tolerance limits. Numerical examples indicate that the approximations are very reasonable. These considerations are extended to the 'generalized' tolerance limits which are analogous to fixed-width confidence intervals with specified confidence coefficient. Also considered are tolerance limits with a specified precision. GRA

N77-11789# Kentucky Univ., Lexington. Dept. of Statistics.
AUGMENTING LEHMAN ALTERNATIVES
Z. Govindarajulu Feb. 1976 14 p refs
(Contract N00014-75-C-1003; NR042295)
(AD-A023789; TR-98; TR-13-ONR) Avail: NTIS
HC A02/MF A01 CSCL 12/1

Generalized classes of Lehmann alternatives are given and locally most powerful (LMP) tests with respect to these alternatives are derived for the two-sample case. These tests turn out to be linear combinations of Savage's (1956) and the Mann-Whitney-Wilcoxon test. By considering such combination of tests one can increase asymptotic relative efficiency. For a certain hypothesis--testing problem, an asymptotically distribution-free test is obtained. These considerations can be extended to one and c(c=2) sample problems. GRA

N77-11790# Massachusetts Inst. of Tech., Cambridge.
ANALYSIS OF A SIMPLE FACTORIZATION ALGORITHM
Donald E. Knuth and Luis Trabb Pardo Jan. 1976 62 p refs
(Contract N00014-70-A-0362-0001; Grant
NSF DCR-72-03752; NR Proj. 044-402)
(AD-A024416) Avail: NTIS HC A04/MF A01 CSCL 12/1

The probability that the k-th largest prime factor of a number n is at most n to the (x) power is shown to approach a limit F sub K(x) as n approaches infinity. Several interesting properties of F sub K(x) are explored, and numerical tables are given. These results are applied to the analysis of an algorithm commonly used to find all prime factors of a given number. The average number of digits in the k-th largest prime factor of a random m-digit number is shown to be asymptotically equivalent to the average length of the k-th longest cycle in a permutation on m objects. Author (GRA)

N77-11791# Mathematica, Inc., Princeton, N.J. Mathtech Div.
ANALYSIS OF UNIFIED TESTING THEORY Final Report
26 Mar. 1976 91 p refs
(Contract DAAA21-76-C-0025)
(AD-A023872) Avail: NTIS HC A05/MF A01 CSCL 12/1

Components of a munition are supplied to the arsenal by a producer. The arsenal requires that these components be reliable. During the production phase of a lot of components, testing is required to be performed by the producer to assure this reliability. The producer is required to use statistical procedures which are thoroughly detailed in appropriate military standards. Military standards 105D and 1235A together with the military specification guide for each component define the sampling procedures and criterion to be used in judging whether a lot is acceptable. The objective of this report is to analyze various testing methodologies to determine if there exists a basis for modifying existing test procedures in order to minimize the costs involved in sampling plus the costs in making wrong decisions in accepting or rejecting lots. To accomplish this objective, P.A. personnel selected the 105 mm artillery for the study. Because the study was a feasibility study, and because the funding and term of the contract was limited, the numerical results which are tabulated in this report are only based on the 70 of the 840 lots which were available from the computer. Aside from the actual numbers in the tables, the methodology which is used is statistically sound, gives a savings in testing costs for this particular example. In general, an application of the design which is recommended will approximately minimize total costs when the costs of decision errors are included with shipping costs. GRA

N77-11792# Naval Postgraduate School, Monterey, Calif.
THE INFLUENCE OF DATA ORDER ON THE LIEBERMAN-ROSS METHOD Final Report, Oct. - Dec. 1975
Arthur L. Schoenstadt Apr. 1976 44 p refs
(AD-A024518; NPS-53Zh76047) Avail: NTIS
HC A03/MF A01 CSCL 12/1

A statistically exact procedure for producing lower bounds on the reliability of a parallel system of independent, exponentially failing components has been produced by Lieberman and Ross. This method uses individual component failure data to estimate system characteristics. The method has the drawback that permuting the order in which components fail (but not the inter-failure times), can alter the estimated bound, i.e., the estimates are Data Order Dependent. In this paper we investigate this dependence of the estimates, and consider the effects of a prior ordering. Author (GRA)

N77-11793# Washington Univ., Seattle. Dept. of Mathematics.
NONLINEAR OPTIMIZATION AND GENERALIZED LAGRANGE MULTIPLIERS Interim Scientific Report, 1975
R. Tyrrel Rockafellar 21 Feb. 1976 12 p refs
(Grant AF-AFOSR-2269-72; AF Proj. 9749)
(AD-A024413; AFOSR-76-0522TR) Avail: NTIS
HC A02/MF A01 CSCL 12/1

Seven papers are described. They are in the areas of stochastic programming, nonlinear programming, and optimal control. Author (GRA)

N77-11794# Wisconsin Univ., Madison. Dept. of Statistics.
SOME ASPECTS OF BIVARIATE REGRESSION SUBJECT TO LINEAR CONSTRAINTS
G. C. Tiao, W. Y. Tan (Washington State Univ.), and Y. C. Chang (Notre Dame Univ.) Sep. 1975 36 p refs
(Grants DA-ARO(D)-31-124-72-G162; DAHC04-76-G-0010)
(AD-A024255; UWIS-DS-75-400) Avail: NTIS
HC A03/MF A01 CSCL 12/1

This paper considers a two-equation linear model when a subset of the parameters in one of the equations is subject to zero constraints. Inference procedures are presented both in the Bayesian and sampling theory framework. Specifically, posterior distributions and confidence distributions of the parameters, as well as various test procedures, are derived and illustrated with examples. The effect of the zero constraints on these procedures is discussed, and a comparison of the Bayesian with the sampling results is given. GRA

N77-11795# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering.
DESIGN OF STOCHASTIC LINEAR CONTROL SYSTEMS ACCORDING TO CUMULANT BASED PERFORMANCE CRITERIA
R. C. Hartwig Apr. 1976 60 p refs
(Contracts N00014-73-A-0434-0002; N00014-75-C-0779; RR0210501)
(AD-A025078) Avail: NTIS HC A04/MF A01 CSCL 12/1

A set of performance statistics known as cumulants show the way to new design criteria for stochastic linear control systems. The new criteria allows the designer to affect the probability distribution of performance measures which does away with the need for stochastic simulation. Controllers arising in this new format are linear-dynamical and exhibit the classical separation property. A class of controllers which is sub-optional with respect to the new criteria is developed. Controller performance within this class is compared to controller performance resulting from the new design criteria. Author (GRA)

N77-11796# Michigan Univ., Ann Arbor. Dept. of Statistics.
A BAYESIAN APPROACH TO TWO-STAGE SAMPLING Final Report, 1 May 1972 - 1 Jan. 1976
W. A. Ericson Wright-Patterson AFB, Ohio AFFDL Feb. 1976 32 p refs
(Contract F33615-72-C-1213; AF Proj. 7071)
(AD-A025624; AFFDL-TR-75-145) Avail: NTIS
HC A03/MF A01 CSCL 12/1

In several previous papers, the author has shown that various standard sampling designs are optimal in a Bayesian sense under corresponding classes of prior distributions on the N-dimensional vector of unknown characteristics of the N elements of a finite population. In this manner a Bayesian interpretation of simple random sampling, stratified random sampling, and of various ratio and regression estimators has been given. In the present report this work is extended to two-stage balanced sampling. Additionally, a simple result on a representation of finitely exchangeable discrete random variables is given which gives a slight generalization of a seemingly little-known result of de Finetti. Also a general tie between Bayes posterior means and traditional WLSE's and BLUE's is obtained, generalizing previous results given by the author. Author (GRA)

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N77-11797# Michigan Univ., Ann Arbor. Dept. of Industrial and Operations Engineering.
A CLASS OF NETWORK DECOMPOSITION SWITCHES
William B. Cherry (Vector Res. Inc., Ann Arbor, Mich.) and Don C. McNickle Dec. 1975 12 p refs
(Contract N00014-75-C-0492; NR Proj. 042-296)
(AD-A024325; TR-75-12) Avail: NTIS HC A02/MF A01 CSCL 12/2

The importance of switching in queueing networks is well documented. In this paper we define a class of switches whose output processes are Markov renewal processes. It is shown that the subclass of switches containing most of the known results on switching outputs requires that the inputs to the switch be a Markov renewal process. GRA

N77-11798# George Washington Univ., Washington, D.C. Inst. for Management Science and Engineering.
ON APPROXIMATING AND BOUNDING GI/M/c QUEUES
Faiz A. Al-Khayyal and Donald Gross 21 Oct. 1976 50 p refs
(Contract N00014-75-C-0729; NR Proj. 347-020)
(AD-A023975; Serial-T-323) Avail: NTIS HC A03/MF A01 CSCL 12/2

Approximate steady-state measures of effectiveness and state probabilities for GI/M/c and approximate bounds on these quantities for GI/M/1 are developed, requiring only the knowledge of the first two moments of GI. These are based on the ability to approximate and bound the single root, in (0,1), of the generating function equation associated with the GI/M/c queue. A method for obtaining this root for any GI, and the special cases GI = gamma and hyperexponential (H) are discussed. Approximations to the root using GI = gamma or H, where the first two moments of GI are matched to those of gamma and H, are shown empirically to be good when the traffic intensity is at least moderate (greater than 0.5). GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N77-11799 Temple Univ., Philadelphia, Pa.
ON SEMIUNIFORM WEAKLY INVERSE SEMIGROUPS AND SEMIUNIFORM INVERSE SEMIGROUPS Ph.D. Thesis
Ellen Hetland Fenwick 1976 45 p
Avail: Univ. Microfilms Order No. 76-22092

Weakly inverse semigroups are generalized to semiuniform weakly inverse semigroups by replacing the equality relation on a weakly inverse semigroup by a congruence relation derived from a semiuniformity so that the factor semigroup is a weakly inverse semigroup. The semiuniform inverse semigroup is a special case of the semiuniform weakly inverse semigroup, and the factor semigroup of a semiuniform inverse semigroup is an inverse semigroup. Given a semiuniform space, the associated set of all bi-semiuniform relations is always a semiuniform inverse semigroup. Any semiuniform inverse semigroup can be represented in a semiuniform inverse semigroup of bisemiuniform relations. The representation is a semiuniform function, and an additional condition yields that the inverse of that function is a semiuniform relation. Dissert. Abstr.

N77-11800 Oregon State Univ., Corvallis.
EVEN ORDER SUBGROUPS OF FINITE DIMENSIONAL DIVISION RINGS Ph.D. Thesis
Gary Robert Greenfield 1976 112 p
Avail: Univ. Microfilms Order No. 76-23516

The notion of K-adequacy is studied under the assumptions that K is an algebraic number field or p-local field and G is a noncyclic group of even-order. Results in this area depend upon the classification of K-division rings by means of Hasse invariants, and Amitsur's classification of those finite groups which can be embedded in the multiplicative group of some division ring. It is shown that if K is an algebraic number field then there exists a noncyclic group of even-order which is K-adequate. It is shown that this is not true if K is a p-local field and necessary and sufficient conditions are determined on K for there to exist a noncyclic group of even-order which is K-adequate. Dissert. Abstr.

N77-11801 Vanderbilt Univ., Nashville, Tenn.
ALMOST COMPLETELY DECOMPOSABLE GROUPS Ph.D. Thesis
Angela Buzzett Shiflet 1976 87 p
Avail: Univ. Microfilms Order No. 76-22365

A torsion-free Abelian group G is said to be almost completely decomposable if it is quasi-isomorphic to a completely decomposable group or, equivalently, G contains a completely decomposable subgroup C such that G/C is bounded. Such a C will be called a quasi-regulating subgroup of G. An infinite rank almost completely decomposable group does not contain a regulating subgroup. A homogeneous almost completely decomposable group is completely decomposable and any two quasi-regulating subgroups of G are isomorphic. If G does contain a regulating subgroup and if either G is separable, then G is completely decomposable. Pure subgroups of an almost completely decomposable group need not be almost completely decomposable. Partial results, however, are obtained which suggest that direct summands are completely decomposable. A great many rather specialized results are obtained by imposing various sorts of chain conditions on the types that occur for the elements of a given group. Dissert. Abstr.

N77-11802 Massachusetts Univ., Amherst.
COMPACT TRANSITIVE ISOMETRY GROUPS Ph.D. Thesis
Gordon Waite Lukesh 1976 59 p
Avail: Univ. Microfilms Order No. 76-22274

Compact Riemannian manifolds having a large transitive isometry group are investigated. Let M be a compact m-dimensional manifold, and let K be the group of isometries of some Riemannian metric or M. Then by a well known classical result K is a compact Lie group, and the dimension of K is bounded above by $m(m+1)/2$. If the dimension of K equals $m(m+1)/2$, then M is either a standard sphere or real projective space. Compact Riemannian manifolds are classified as having a transitive group of isometries of dimension at least sq m/4 + m/2x(greater than or equal to 19). Using the variation technique, it is shown that there are uncountably many distinct homogeneous metrics on V(nx2) having SO(2)xSO(n) as full isometry group. Dissert. Abstr.

N77-11803 Massachusetts Univ., Amherst.
CHARACTERIZATION THEOREM FOR TOPOLOGICAL SEMILATTICES ON THE TWO-CELL Ph.D. Thesis
Ellen Mary Shipley Stenson 1976 61 p
Avail: Univ. Microfilms Order No. 76-22302

A characterization for those semilattices which are homomorphic images of subsets of I x I is considered. It is shown that a necessary and sufficient condition for a topological semilattice with identity on the two cell to be such a semilattice is that it satisfies the following criterion: Hypothesis M: If a and b are elements of the same boundary arc of S such that a comes before b in the natural cut-point ordering, and if x is an element of S which is not in cT for any c between zero and b, then x not greater than b implies ax less than or equal to ab. Dissert. Abstr.

N77-11804 Rice Univ., Houston, Tex.
HIGHER K-THEORY OF REGULAR RINGS Ph.D. Thesis
Clayton Collier Sherman 1976 175 p
Avail: Univ. Microfilms Order No. 76-21711

Let A be a discrete valuation ring with field quotients F and residue class field A/m, where m denotes the unique maximal ideal of A. Let delta:K sub n+1(F) yield K sub n (A/m) denote the connecting homomorphism in Quillen's localization sequence for A, and let d:K sub n(a) yield K sub n+1(F) denote the map induced by the canonical projection A yields K sub n+1(F) such that delta x p = r. Theorem 2: With notation as above, suppose that A is a k-algebra (k a field), where A/m is a finite separable

extension of K. Then the localization sequence for A breaks up into split short exact sequences. Theorem 3: Let F be a field, and let F(X) denote the ring of polynomials in one variable over F. Let S denote the monoid defined by complements over some collection of M of maximal ideals of F(X). Then the localization sequence for the Dedekind ring F(X)S breaks up into split short exact sequences. Theorem 4: There exists a homomorphism br:Kn(A/m) yields Kn(A) such that r x br = 1. Combining theorems 1 and 4, theorem 5 is obtained: The localization sequence for A breaks up into split short exact sequences. Dissert. Abstr.

N77-11805 Pennsylvania Univ., Philadelphia.
ON THE EXPONENTIAL MAP OF A LIE GROUP Ph.D. Thesis
Heng-Lung Lai 1976 56 p
Avail: Univ. Microfilms Order No. 76-22723

Let G' be a connected (real or complex) Lie group with Lie algebra G. In general, the exponential map exp: G yields G' is not onto. But for any element g in SL(n,R), sq g lies on some 1-parameter subgroup. The analogous problem is considered for an arbitrary connected Lie group G'. Dissert. Abstr.

N77-11806# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
CRITICAL CUTSETS OF GRAPHS AND CANONICAL FACETS OF SET PACKING POLYTOPES
Egon Balas Feb. 1976 15 p ref
(Contract N00014-75-C-0621; Grant
NSF MPS-73-08534-A02; NR Proj. 047-048)
(AD-A023854; WP-59-75-76; RR-385) Avail: NTIS HC A02/MF A01 CSCL 12/2

A cutset in a graph G with node set N is the set of edges joining the nodes in a subset of N to those not in the subset. A cutset is called critical if its removal produces a graph whose independence number is greater than that of G. The concept of a critical cutset is used to give first a necessary, then a sufficient condition for an inequality with 0-1 coefficients to be a facet of the set packing polytope defined by G. GRA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N77-11807 Wesleyan Univ., Middletown, Conn.
A NEW METHOD FOR MEASURING THE NEWTONIAN GRAVITATIONAL CONSTANT, G Ph.D. Thesis
William Almon Koldewyn 1976 179 p
Avail: Univ. Microfilms Order No. 76-23702

A measurement of the Newtonian gravitational constant, G, incorporates a thick walled cylinder or doughnut geometry for the attracting masses that results in a region in which the gravitational field strength is position independent. Two 265 g test masses are attached 33 cm apart at the ends of a quartz tube. This dumbbell is suspended horizontally in a vacuum chamber by means of a magnetic suspension which allows gravitational forces to dominate. The torsional couple, in the absence of the attracting masses, is due mostly to the horizontal gravitational gradient in the room. The angular position of the pendulum is recorded at 100 sec intervals and the data Fourier analyzed to determine the pendulum period. This information together with the statically determined system dimensions and masses determines G. Dissert. Abstr.

N77-11808 Colorado Univ., Boulder.
TORSION AND THE GEOMETRY OF SPIN Ph.D. Thesis
Thomas David Martin 1976 137 p
Avail: Univ. Microfilms Order No. 76-23652

A formal development of the differential geometry of manifolds with non-zero torsion is reported. The geometric significance of the torsion tensor is extensively explored. A compendium of basic ideas which serve to establish a language for manifolds with torsion is presented, and various concepts and distinctions are provided which clarify the interdependence of the geometry induced by a notion of an affine connection and that which is induced by a metric tensor. This gives structure and organization to the complex of resulting non-Riemannian manifolds. A geometrically significant decomposition of the torsion which distinguishes its spin effects from its translational effects is obtained, and connections which are based on these special parts are investigated. In essence, the torsion tensor characterizes the rotational degrees of freedom of geometry in a way analogous to that in which the curvature tensor characterizes its translational degrees of freedom. Dissert. Abstr.

N77-11809 Pennsylvania Univ., Philadelphia.
DYNAMICS OF INERTIA VARIANT MACHINERY Ph.D. Thesis
George Constantine Hud 1976 247 p
Avail: Univ. Microfilms Order No. 76-22706

It is shown how Lagrange's form of d'Alembert's principle can be successfully adapted to a systematic modelling procedure for automatically generating the equations of motion, and associated equations of constraint, for multi-loop, multi-freedom mechanical systems. Using this principle, a general purpose, user-oriented computer program, DYMAC, for solving planar problems involving either lower or higher order pairings has been developed and tested. The logic for internally generating the required differential and algebraic equations in this program was designed with the intent of minimizing the amount of user input and analysis. Two versions of DYMAC have been produced. One version of the program analyzes the most frequently occurring problems--those with lower order pairings only. The second version is capable of solving problems which contain both higher and lower order pairings. Dissert. Abstr.

N77-11810 Pennsylvania Univ., Philadelphia.
MAGNETOELASTIC INTERACTIONS IN $SmCo_5$ Ph.D. Thesis
Daryl Ann Doane 1976 449 p
Avail: Univ. Microfilms Order No. 76-22680

The values of the magnetostriction and elastic constants were used to estimate the contributions to the coercive force from various mechanical imperfections. In this connection, disordered regions were considered to have changes in composition relative to that of stoichiometric $SmCo_5$ in commercial permanent magnet materials. These disordered regions were modeled as precipitates having coherent strain fields and bounds by dislocation loops. In order to handle the inherently random nature of the distribution of precipitates within LPS material, a new statistical theory of the coercive force using the theory of stochastic processes was developed. Using experimentally determined quantities, it was calculated that the contribution to the coercive force from the coherent strain of the precipitates could be over one tesla. Dissert. Abstr.

N77-11811 Pennsylvania Univ., Philadelphia.
CONFORMAL AND NON-HERTZIAN CONTACT PROBLEMS Ph.D. Thesis
William Stewart Woodward 1976 279 p
Avail: Univ. Microfilms Order No. 76-22805

A general numerical method of solution for three dimensional, frictionless, conformal, elastic contact problems is presented. The method was used to analyze the conformal contact of a sphere indenting a spherical seat and a cylinder indenting a cylindrical seat. The results of the sphere-spherical seat problem compared well with experimental data. Results of the cylinder-cylindrical seat problems were in close agreement to a known analytic solution of this problem. For both analyses, results compared favorably with Hertzian theory for problems with small contact regions. Dissert. Abstr.

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N77-11812 Massachusetts Univ., Amherst.
MEASUREMENT AND PREDICTION OF SOUND ATTENUATION BY HIGHWAY BARRIERS USING ACOUSTIC MODELING TECHNIQUES Ph.D. Thesis

Nelson David Lewis 1976 214 p
Avail: Univ. Microfilms Order No. 76-22241

A series of analytical models, using Maekawa's design curve as a basis, have been developed to predict the excess attenuation of single wall and double wall highway barriers of finite and infinite length. These models include the sound propagation paths of the specular ground reflections and the path around the ends of the finite length barrier. A group of digital computer programs have been developed from the model. Dissert. Abstr.

N77-11813 Georgia Inst. of Tech., Atlanta.
MATHEMATICAL MODELS OF ACOUSTIC AND ACOUSTIC-GRAVITY WAVE PROPAGATION IN FLUIDS WITH HEIGHT-DEPENDENT SOUND VELOCITIES Ph.D. Thesis
Wayne Alan Kinney 1976 172 p
Avail: Univ. Microfilms Order No. 76-23735

Several problems which relate to the propagation of acoustic and acoustic-gravity waves in a medium whose properties vary with height only are considered with the intent of refining existing schemes for the synthesis of waveforms. The contribution from very low frequencies to a modal synthesis of an acoustic-gravity waveform is clarified, and a guide is provided for adapting a computer program to include such contributions in the synthesis of waveforms. The asymptotic high-frequency behavior of guided modes is explained by use of the W.K.B.J. approximation. Finally, a geometric acoustical scheme is outlined for the prediction of the amplitudes of waves that propagate over long distances. A number of FORTRAN subprograms are provided that exemplify the numerical implementation of this scheme. Recommendations are given for the refinement at low and high frequencies of schemes for the synthesis of waveforms. Dissert. Abstr.

N77-11814 Massachusetts Univ., Amherst.
MEASUREMENT AND PREDICTION OF SOUND ATTENUATION BY BUILDINGS USING ACOUSTIC MODELING TECHNIQUES Ph.D. Thesis
Elizabeth Spencer Ivey 1976 117 p
Avail: Univ. Microfilms Order No. 76-22266

An analytic model is presented for predicting the noise attenuation characteristics of barriers ranging from thin screens to building-size widths, both in the free field and over ground surfaces. The model provides for double edge diffraction, scattering and absorption at the barrier surfaces, and the acoustical properties of the surface on which the barrier is placed. A high level of correlation is found between the predicted attenuation levels obtained with the model and those measured with a scale model. Dissert. Abstr.

N77-11815*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OTW NOISE CORRELATION FOR SEVERAL NOZZLE/WING GEOMETRIES USING A 5:1 SLOT NOZZLE WITH EXTERNAL DEFLECTORS
U. Vonglahn 1976 28 p refs Presented at the 92nd Meeting of the Acoustical Soc. of Am., San Diego, Calif., 16-19 Nov. 1976
(NASA-TM-X-73529; E-8949) Avail: NTIS HC A03/MF A01 CSCL 20A

Acoustic spectral data obtained from a model-scale study of several over the wing (OTW) configurations with a 5:1 slot nozzle using various external deflectors are correlated in terms of deflector geometry and flow parameters. Variations in the deflector geometry include deflector size and deflector angle. In addition, geometry variations in flap setting and nozzle chordwise location are included. Three dominant noise sources are correlated: fluctuating lift noise, flap trailing edge noise, and jet mixing noise. Aerodynamic characteristics including lift and thrust measurements, obtained for the various configurations are summarized. Author

N77-11816*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE ACOUSTIC MONOPOLE IN MOTION
Thomas D. Norum and Chen-Huei Liu Nov. 1976 28 p refs Presented at 92d ASA Meeting, San Diego, 16-19 Nov. 1976
(NASA-TM-X-73985) Avail: NTIS HC A03/MF A01 CSCL 20A

The results of an experiment are presented in which a small monochromatic source which behaves like an acoustic monopole when stationary is moved at a constant speed over an asphalt surface past stationary microphones. An analysis of the monopole moving above a finite impedance reflecting plane is given. The theoretical and experimental results are compared for different ground to observer heights, source frequencies, and source velocities. A computation of the effects of source acceleration on the noise radiated by the monopole is also presented. Author

N77-11817*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODAL DENSITY FUNCTION AND NUMBER OF PROPAGATING MODES IN DUCTS
E. J. Rice 1976 19 p refs Presented at the 92d Meeting of the Acoust. Soc. of Am., San Diego, Calif., 16-19 Nov. 1976
(NASA-TM-X-73539; E-8699) Avail: NTIS HC A02/MF A01 CSCL 20A

The question of the number of propagating modes within a small range of mode cut off ratio was raised. The population density of modes were shown to be greatest near cut off and least for the well propagating modes. It was shown that modes of nearly the same cut off ratio behave nearly the same in a sound absorbing duct as well as in the way they propagate to the far. Handling all of the propagating modes individually, they can be grouped into several cut off ratio ranges. It is important to know the modal density function to estimate acoustic power distribution. Author

N77-11818# Booz-Allen Applied Research, Inc., Bethesda, Md.
STATISTICAL MODEL OF SONIC BOOM STRUCTURAL DAMAGE Final Report
Robert L. Hershey and Thomas H. Higgins Jul. 1976 141 p refs
(Contract DOT-FA72WA-2823)
(AD-A028512/2; FAA-RD-76-87) Avail: NTIS HC A07/MF A01

The probabilities of structural damage from sonic booms were estimated for various susceptible structural elements using a statistical modeling technique. The breakage probabilities were found to vary widely with the specific material configuration, but to consistently increase with increasing nominal overpressures. The ranges of breakage probabilities at a nominal overpressure of 1 psf for typical configurations of susceptible materials are given. The results of the modeling tend to agree well with sonic boom claims experience. Author

N77-11819# Institut Franco-Allemand de Recherches, St. Louis (France).
STUDY OF ACOUSTIC WAVE PROPAGATION IN THE ATMOSPHERE. FEASIBILITY OF AN EXPERIMENTAL STUDY IN THE ISL SONIC BOOM GENERATOR [ETUDE DE LA PROPAGATION ATMOSPHERIQUE DES ONDES SONORES FAISABILITE DE L'ETUDE EXPERIMENTALE DANS LE GENERATEUR DE BANG DE L'ISL]
P. G. Sava and J. Juret 20 Feb. 1974 53 p refs In FRENCH
(Contract STAe-73/93409)
(ISL-4/74) Avail: NTIS HC A04/MF A01

The atmospheric absorption of sound waves due to effects such as viscosity, thermal conduction, and thermodynamic nonequilibrium (molecular relaxation) was calculated. The deformation of finite amplitude waves due to nonlinearity effects during their propagation in the atmosphere and leading to the introduction of harmonics is evidenced and the interest of investigating the influence of sound wave intensity on the atmospheric absorption coefficient is emphasized. The feasibility of an experimental investigation of audio frequency sound waves propagating along a 50 m distance in the ISL sonic boom generator was analyzed. The experimental design is described. Results of wave distortion and attenuation measurements are discussed. The feasibility of this experimental study is shown. ESA

N77-11820# Naval Underwater Systems Center, New London, Conn.
SCATTERING FROM LARGE PLANAR GRATINGS OF COMPLIANT CYLINDRICAL SHELLS
Gerald A. Brigham, John J. Libuha, and Ronald P. Radlinski 27 Apr. 1976 59 p refs

(SF11121702; NUSC Proj. A-700-11)
(AD-A025279; NUSC-TR-5327) Avail: NTIS HC A04/MF A01 CSCL 20/1

A two-dimensional mathematical model for estimating the scattering of plane acoustic waves from an infinite, uniform, plane grating of compliant, elliptical, cylindrical shells is developed. Calculations from the mathematical model are found to be in reasonable agreement with measurements of large experimental arrays. The array is shown to be analogous to a multi-tuned, acoustic band rejection filter that has the shell's fundamental flexural mode in the array for its center frequency. General low frequency approximations are made, the scattering matrix is truncated at the quadrupole mode, and the array transmission is computed for several specific geometries. Conditions for an ultra-wide resonance bandwidth having very high array resonance reflectivity for pressure compensated elements are considered. Alternative applications for compliant tube gratings, e.g., as an acoustic window that provides mechanical shading for a sonar receiving array, are discussed. GRA

N77-11821# Tracor Sciences and Systems, Austin, Tex.
AIRPORT NOISE MONITORING SYSTEMS, TASK A Final Report, Jul. 1974 - Nov. 1975
B. K. Cooper and Richard D. Edmiston Nov. 1975 279 p refs
(Contract DOT-FA74WA-3539)
(AD-A028511/4; T75-AU-7531U; FAA-RD-75-216) Avail: NTIS HC A13/MF A01 CSCL 01/5

Five U. S. and five European comprehensive aircraft noise measurement systems were visited and studied. For each system, a description is given of remote monitor station equipment, central station equipment, data processing and output, staffing and costs for installation and operation, and associated noise abatement program. The systems and associated equipment are compared and evaluated. The application of monitoring systems to airport noise abatement is discussed. Author

N77-11822# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
PHOTOLITHOGRAPHIC TECHNIQUES FOR SURFACE ACOUSTIC WAVE (SAW) DEVICES Quarterly Report, 26 Jan. - 30 Apr. 1976
A. R. Janus, T. W. Bristol, G. W. Judd, and W. R. Smith, Jr. Apr. 1976 16 p
(Contract DAAB07-75-C-0044)
(AD-A025492) Avail: NTIS HC A02/MF A01 CSCL 09/5

The object of the program is the establishment of a production capability for surface acoustic wave devices of varied design and material for the purpose of meeting estimated military needs for a period of two years after the completion of the contract and to establish a base and plans which may be used to meet expanded requirements. The primary requirement is the pilot line production of devices that are reliable, reproducible, and low cost. The second phase of this program has required a finalization of six electrical specifications on bandpass, tapped delay line and pulse compression filter. Ten devices of each of the designs are currently being fabricated for shipment at the end of this phase. These devices will be packaged in semiconductor platform pin packages. GRA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N77-11823 Vanderbilt Univ., Nashville, Tenn.
MEASUREMENTS OF ENERGY LOSSES, DISTRIBUTIONS OF ENERGY LOSS AND ADDITIVITY OF ENERGY LOSSES FOR 50 TO 150 KeV PROTONS IN HYDROGEN AND NINE HYDROCARBON GASES Ph.D. Thesis
John Hill Thorngate 1976 99 p
Avail: Univ. Microfilms Order No. 76-22370

Energy-loss distributions were measured for 51, 102, and 153 KeV protons traversing hydrogen, methane, ethyne (acetylene), ethene (ethylene), ethane, propyne (methyl acetylene), propadiene (allene), propene (propylene), cyclopropane and propane. An investigation was made to determine if the type of carbon bonding in a hydrocarbon molecule affects the shape of the distribution. Stopping powers and stopping cross sections were also measured at these energies and at 76.5 and 127.5 KeV to determine effects of chemical binding. All of the measurements were made at the gas density required to give a 4% energy-loss. The mean energy, second central moment (a measure of the width of the distribution), and the third central moment (a measure of the skew) were calculated from the measured energy-loss distributions. Dissert. Abstr.

N77-11824 Colorado Univ., Boulder.
BROWNIAN MOTION OF INTERACTING PARTICLES Ph.D. Thesis
Bruce J. Ackerson 1976 257 p
Avail: Univ. Microfilms Order No. 76-23583

The generalized Smoluchowski equation, including the hydrodynamic interaction and corrections for ion cloud effects, was used to describe interacting particles for the temporal and spatial regimes probed by light heating spectroscopy. This equation is treated in three different ways to extract information. First, the equation is used to find cumulants of decay of the intermediate scattering function. The first cumulant is calculated with and without the hydrodynamic interaction. The second cumulant is calculated without the hydrodynamic interaction. Second, the generalized Smoluchowski equation is reduced to a simple diffusion equation. The resulting diffusion constant depends upon the interparticle forces. In the limit of weak interaction between particles, the reduced equation and the method of cumulants give the same result. Third, the generalized Smoluchowski equation is solved for the model system of a linear chain of colloidal particles interacting via nearest neighbor harmonic couplings. Dissert. Abstr.

N77-11825 Rockefeller Univ., New York.
ZEROS OF THE MULTIPARTICLE GENERATING FUNCTION IN HADRONIC SCATTERING MODELS Ph.D. Thesis
Robert Edward Hendrick 1975 72 p
Avail: Univ. Microfilms Order No. 76-23272

A number of mathematical techniques are used to establish the existence of the thermodynamic limit in statistical mechanics to study the behavior of the nearest zero of multiparticle generating functions in various classes of hadronic scattering models. First, the nearest zero of the multiparticle generating function in models is related to the nearest zero for the true multiparticle generating function, given simple conditions on the correspondence between the model and the true production cross sections. Next, studying simple multiperipheral production models mathematical tools are developed to determine the behavior of the nearest zero in the limit of infinite scattering energy. Such simple multiperipheral models, and more complicated two body interaction models, are shown to have non-shrinking nearest zeros under raasonable conditions on the production amplitudes or particle interactions. Dissert. Abstr.

N77-11826 Rice Univ., Houston, Tex.
COLLISIONAL IONIZATION OF XENON ATOMS IN WELL DEFINED HIGH RYDBERG STATES Ph.D. Thesis
William Philip West 1976 105 p
Avail: Univ. Microfilms Order No. 76-21721

The first absolute measurements of collisional ionization of high Rydberg atoms in well defined states are discussed. Rate constants and cross sections for Xe(+) production resulting from collisions of SF6 molecules with Xe atoms in quantum states are reported. The following aspects of the experiment are discussed in detail: (1) production of highly excited atoms by photoexcitation using a pulsed dye laser; (2) absolute detection of atoms in high Rydberg states using the field ionization technique; (3) measurement of the radiative lifetimes of highly excited atoms; (4) measurement of ion production resulting from collisional ionization. The measured rate constants are, to within experimental uncertainty, independent of n and equal to .00000038 cu cm/sec. The rate constants were also found to be influenced by the presence of an electric field. Dissert. Abstr.

N77-11827 Adelphi Univ., Garden City, N.Y.
THE GROUND STATE ELECTRONIC STRUCTURE OF ATOMIC BORON Ph.D. Thesis
Frank Anthony Spagnolo 1976 432 p
Avail: Univ. Microfilms Order No. 76-22819

A non-relativistic Unrestricted Hartree-Fock analysis of the ground state electronic structure of atomic boron is carried out using a spin-polarized, two-determinant approximation to the multi-determinant proper spin eigenfunction. The two-determinant wave function is derivable from a generalized spinor representation. The spin products are taken over pairs of core orbitals, and alpha sub j denotes the spin configuration of the valence orbital. A variational analysis results in a system of coupled nonlinear integrodifferential equations with full exchange. These are solved numerically, employing an iterative procedure self-consistent to approximately 0.000003. Dissert. Abstr.

N77-11828 Polytechnic Inst. of New York.
RADIATION FROM A COLLECTION OF ABSORBING RESONANT SYSTEMS IN THE PRESENCE OF BOUNDARIES OF INTENSE FIELDS Ph.D. Thesis
Bruce Nelson Perry 1976 164 p
Avail: Univ. Microfilms Order No. 76-23440

Two state single atom spontaneous emission rates were considered, the angular distribution of the spontaneously radiated power, and the transition frequency shifts when the atoms are located in thermal fields with resonances in their spectral energy density induced by boundaries. Spontaneous electric and magnetic dipole transitions are discussed. Results are presented for dipoles near dielectric interfaces, near plane mirrors, and in infinite aperture Fabry-Perot interferometers. The thermal radiation properties of highly absorbing resonant systems were investigated by considering many two state atoms, each dynamically coupled to a thermalizing mechanism and to a common quantized radiation field. In order to treat radiation from systems with discrete energy spectra driven by strong periodic fields Floquet's theorem is exploited in operator form to yield a complete dynamical description in terms of time-independent Hamiltonians.
Dissert. Abstr.

N77-11829 Princeton Univ., N.J.
INELASTIC NEUTRON SCATTERING IN SOLID NEON AT HIGH PRESSURE Ph.D. Thesis
Juergen Eckert 1975 141 p
Avail: Univ. Microfilms Order No. 76-22595

The phonon dispersion relations in a high density Ne crystal have been measured in the 100, 110, and 111 symmetry directions at 8 K using a triple axis neutron spectrometer. The data is analyzed using harmonic Born-von Karman force constants with the result that the interatomic forces in this Ne crystal are predominantly central in nature. The data is found to be well represented in the harmonic approximation by a Lennard-Jones potential. A dispersion of mode Grueneisen parameters is used to obtain the macroscopic Grueneisen parameter. Comparisons are given with theoretical calculations. Quasiharmonic calculations are shown to over estimate the volume dependence of the phonon energies. Thermodynamic analysis using the density of phonon states shows the decreased importance of zero-point motion in the high density crystal. Dissert. Abstr.

N77-11830*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TABULATION OF HYBRID THEORY CALCULATED e-N2 VIBRATIONAL AND ROTATIONAL CROSS SECTIONS
N. Chandra and A. Temkin Washington Oct. 1976 91 p refs
(NASA-TN-D-8347; G-7T05J2) Avail: NTIS HC A05/MF A01 CSCL 20H

Vibrational excitation cross sections of N2 by electron impact are tabulated. Integrated cross sections are given for transitions v yields v prime where o=or < v=or < 8 in the energy range 0.1 eV=or < E=or <10 eV. The energy grid is chosen to be most dense in the resonance region (2 to 4 eV) so that the substructure is present in the numerical results. Coefficients in the angular distribution formula (differential scattering cross section) for transitions v=0 yields v prime = or < 8 are also numerically given over the same grid of energies. Simultaneous rotation-vibration coefficients are also given for transitions v=o,j=o; 1 yields v prime=o, j=o,2,4; 1,3,5. All results are obtained from the hybrid theory. Author

N77-11831# California Univ., Livermore. Lawrence Livermore Lab.
HARTREE-FOCK ENERGY CURVES, FOR BrH(+)(X(P2)I), KrH(+)(X1 SIGMA (+)), AND RbH(+)(X 2 SIGMA (+))
M. A. Gardner, A. M. Karo, F. E. McMurphy, and A. C. Wahl 21 Jan. 1976 12 p refs
(Contract W-7405-eng-48)
(UCRL-51738) Avail: NTIS HC A02/MF A01

Restricted Hartree-Fock calculations for the ground electronic states of BrH(+), KrH(+), and RbH(+) were carried out using carefully selected nominal atomic basis sets for the heavy atoms, supplemented with an additional orbital designed to allow for a better description of atomic distortion at intermediate internuclear separations. A flexible four-function basis set was used on the hydrogen atom. Molecular optimization was carried out for the heavy-atom distortion orbital and also for the hydrogen 2p orbital. The interatomic potentials obtained for the X 2PI state of BrH(+) and the X 1 sigma+ state of KrH(+) show strong molecular binding, relative to the neutral heavy atoms plus a proton. The RbH(+) X 2 Sigma(+) calculations give a repulsive interatomic potential with dissociation to Rb(+) and a neutral hydrogen atom. ERA

N77-11832# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
AN INVARIANT IMBEDDING, ORDERS-OF-SCATTERING APPROACH TO PARTICLE TRANSPORT IN A SLAB Physical Sciences Research Papers
John C. Garth and Stanley Woolf 13 Oct. 1976 164 p refs (AF Proj. 5621)
(AD-A024155; AFCRL-TR-76-0023; AFCRL-PSRP-654) Avail: NTIS HC A08/MF A01 CSCL 12/1

A novel, simplified approach to particle transport in slabs is given. The number of particles transmitted and reflected by a slab of finite thickness is obtained as a function of the number of collisions the particles receive. This 'orders-of-scattering' solution is facilitated by an invariant imbedding approach which leads to a set of integral recursion relations between transmitted and reflected particle currents. Solutions are given for both one-dimensional and three-dimensional transport in slabs for an arbitrary anisotropic scattering law. GRA

N77-11833# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
ELECTRONIC ANGULAR MOMENTUM TRANSFER IN THE I(DOUBLET P(1/2)) + NF (A SINGLET DELTA) SYSTEM
J. M. Herbelin and M. A. Kwok Los Angeles AF Station, Calif. SAMSO Mar. 1976 11 p refs
(Contract F04701-75-C-0076)
(AD-A024258; TR-0076(6240-40)-4; SAMSO-TR-76-58) Avail: NTIS HC A02/MF A01 CSCL 07/4

A rate coefficient at 298 K of greater than 2.6 x 10 raised to 14th power cc/-mol-sec has been deduced for the electronic energy transfer: I(doublet P(1/2)) = NF (a singlet Delta) goes to I(doublet P(3/2)) - NF(b singlet Sigma(-)). GRA

N77-11834# Massachusetts Inst. of Tech., Cambridge.
ELECTRON IMPACT IONIZATION CROSS SECTIONS OF GOLD, CHROMIUM AND IRON Final Technical Report, 16 Apr. 1971 - 31 Dec. 1973
A. N. Nelson Jan. 1976 96 p refs
(Contract F33615-71-C-1420; AF Proj. 7367)
(AD-A024208; AFML-TR-75-198) Avail: NTIS HC A05/MF A01 CSCL 07/4

Relative and absolute electron impact ionization cross sections were measured for species of three elements. The data include results on Au(+), Au(2+), Au(3+); Cr(+), Cr(2+); Fe(+), Fe(2+), Fe(3+). Total cross section results on the elements are also reported. A description of the procedure and equipment as well as some of the difficulties in the experiment are presented. Related information from the literature, both experimental and theoretical, are discussed in a comparative context. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N77-11835 California Inst. of Tech., Pasadena.
A STUDY OF SOME TWO-DIMENSIONAL FIELD THEORY MODELS Ph.D. Thesis
Robert Tung-Hsing Wang 1976 177 p
Avail: Univ. Microfilms Order No. 76-23118

Recently it has been pointed out that quantum electrodynamics with a massless fermion in one-space, one-time dimension exhibits behavior which can be interpreted as being analogous to scaling and confinement. To learn more about the occurrence of such behavior, several other two-dimensional quantum field theories are studied. After reviewing the Thirring model, operator solutions of scale-invariant generalizations with internal degrees of freedom are constructed. The physics of these models can be equally well described in terms of a field theory of fermions or of bosons. Because the physical excitations are massless in these models, the physical states can also be described, in general, as many-fermion or many-boson states. Lowenstein and Swieca's operator solution of quantum electrodynamics in two-dimensions is generalized to a model with more than one massless, charged fermion. Dissert. Abstr.

N77-11836 Colorado Univ., Boulder.
PION-NUCLEUS SCATTERING AND THE INVESTIGATION OF NUCLEAR SPIN DEPENDENT EFFECTS Ph.D. Thesis
Martha Susan Iverson 1976 125 p
Avail: Univ. Microfilms Order No. 76-23629

Pion elastic scattering from aligned targets and pion-gamma angular correlations following inelastic scattering are investigated in order to determine nuclear spin dependent effects with pions as projectiles. A density-matrix formulation is employed to treat the scattering between different target spin states. Two forms of pion optical potentials are used to represent elastic pion-nucleus scattering for incident pion energies between 100 and 200 MeV. A collective model generalization with rotational wave functions is employed for the interaction using the distorted wave Born approximation. Dissert. Abstr.

N77-11837 Colorado Univ., Boulder.
STUDIES OF THICK TARGET FAST NEUTRON PRODUCTION AND PROTON ACTIVATION OF THE STABLE ISOTOPE TRACER Ca-48 AS APPLICATIONS OF NUCLEAR PHYSICS IN MEDICINE Ph.D. Thesis
Fredric Marc Edwards 1976 178 p
Avail: Univ. Microfilms Order No. 76-23603

The production of fast neutron beams for radiotherapeutic and proton activation of Ca-48 for use as a stable isotope tracer are examined. The properties of fast neutron beams produced by 26 MeV protons, 17.3 MeV deuterons and 41 MeV He-3 ions incident on targets of beryllium, deuterium gas, and lithium deuteride are examined. A high pressure, high current deuterium gas target was designed and built. Measurements were taken using neutron time-of-flight, Bonner spectrometer, ionization chamber and small volume spherical proportional counter techniques. Beam-target combinations are compared as to total yield, neutron energy, dose rate and microdosimetric properties. It is shown that a deuterium beam incident on a deuterium gas target is the best method for producing fast neutrons for radiotherapy. Dissert. Abstr.

N77-11838 Virginia Univ., Charlottesville.
HIGH SPIN STATES IN Mg-26 AND Na-23 POPULATED BY HEAVY ION REACTIONS Ph.D. Thesis
David Earl Gustafson 1976 72 p
Avail: Univ. Microfilms Order No. 76-22847

Two experiments were used to produce high spin states in sd-shell nuclei. Beams of O-18 and N-15 were extracted from the EN tandem van de Graaff accelerator. Alpha particles from the (C-12)(O-18, alpha)Mg-26 and (C-12)(N-15, alpha)Na-23 reactions were detected with a Borkowski-Kopp proportional counter at the focal plane of an Enge split pole magnetic spectrograph. The differential cross sections extracted for many levels in the respective residual nuclei were averaged over several bombarding energies. These cross sections were analyzed in the framework of the Hauser-Feshbach formalism applicable to compound nuclear reactions. Both reactions are shown to be generally well predicted by the statistical model, though an apparent anomaly exists for certain states observed in the (C-12)(N-15, alpha)Na-23 reaction. Dissert. Abstr.

N77-11839 California Univ., Los Angeles.
A STUDY OF RESONATING GROUP THEORY AND ALPHA-HELIUM ELASTIC SCATTERING Ph.D. Thesis
Donald Ray Fields 1976 111 p
Avail: Univ. Microfilms Order No. 76-22188

The Born-Pade method is utilized to investigate alpha-helium elastic scattering. The resonating group equations based on the force mixture, reid soft core, and super soft core nucleon-nucleon potentials are studied. For the force mixture kernel, it is found that the nonlocal kernel is important for a center of mass energy less than about 250 MeV, and that its single exchange part dominates over its double exchange part. The direct potentials obtained for the more realistic reid soft core and super soft core potentials are found to be substantially different even though they fit roughly the same nucleon-nucleon data. If these direct potentials are used with the force mixture kernel, very different alpha-helium scattering phase shifts are obtained. This result suggests that the kernel also depends sensitively on the nature of the basic nucleon-nucleon potential. Dissert. Abstr.

N77-11840 Colorado Univ., Boulder.
NONLINEAR ION MOTION IN THE SLOW ION CYCLOTRON Ph.D. Thesis
Michael Joseph Ciarvella 1976 47 p
Avail: Univ. Microfilms Order No. 76-23598

The nonlinear cyclotron resonance of a single ion in a coherent, electromagnetic slow ion cyclotron wave is treated analytically for arbitrary polarization and angle of propagation in a homogeneous magnetic field. For parameters of interest in CTR applications, the nonlinear phase space orbits are found to be characterized by the case of parallel propagation. For this case, approximate expressions are obtained for the gyroradius and parallel velocity of the resonant particle. In this approximation, the nonlinear period and adiabatic invariant are found. The treatment is shown to extend to a system with slowly changing parameters. Comparison of the nonlinear frequency with the linear ion cyclotron and electron Landau damping rates indicates that the ion cyclotron heating experiment carried out on the ST Tokamak was pumping into a nonlinear resonance region, before the wave was finally damped by the linear mechanisms. It is found that nonlinear effects could account for the previously unexplained loss of high energy ions. Dissert. Abstr.

N77-11841 Virginia Univ., Charlottesville.
TRANSFORMATION OF HIGH ENERGY ELECTRONS TO MUONS IN THE COULOMB FIELD OF A NUCLEUS Ph.D. Thesis
Gregory Ernest Desobry 1976 109 p
Avail: Univ. Microfilms Order No. 76-22870

The Fermi V-A theory of weak interactions satisfactorily describes all relevant experimental measurements to date. On the other hand, the Fermi interaction, treated as usual in lowest order, predicts a scattering amplitude which continually increases with energy, a result which is in conflict with the condition of unitarity of the S-matrix (conservation of probability) for a contact interaction. The predictions of the Fermi theory for inverse muon decay in the Coulomb field of a nucleus were computed in the lowest order of weak and electromagnetic interactions.
Dissert. Abstr.

N77-11842 Princeton Univ., N.J.
THE RENORMALISATION GROUP AND SCALING AT HIGH ENERGY IN YUKAWA FIELD THEORY Ph.D. Thesis
Nigel Charles Trueman Coote 1976 160 p
Avail: Univ. Microfilms Order No. 76-22591

High energy scattering amplitudes in Yukawa field theory were studied with the aid of renormalization group techniques. The original (inhomogeneous) Callan-Symanzik equations are displayed, and their best-known application to electroproduction

is reordered. The parton model explanation of the observed Bjorken scaling is recalled. Dissert. Abstr.

N77-11843 Pennsylvania Univ., Philadelphia.
COMPOSITION AND EQUATION OF STATE OF THERMALLY DISSOCIATED MATTER AND MASS AND STABILITY OF RIGIDLY ROTATING RELATIVISTIC POLYTROPES Ph.D. Thesis
Kenneth Alan VanRiper 1976 136 p
Avail: Univ. Microfilms Order No. 76-22793

The composition and equation of state of a perfect gas of photons, electrons-positrons, neutrinos, and nucleons are calculated assumming either perfect neutrino transparency or some build up of neutrino concentration in dense matter. The calculations applicable to collapsing stars after thermal dissociation and before nuclear forces are important. The energy of a rigidly rotating star is written in the first and second post-Newtonian approximation. Conditions for equilibrium and stability are derived, as well as evolutionary paths for stars shedding anular momentum or mass. The energy method is applied to low mass whire dwarfs, to semi-relativistic neutron stars, and to supermassive stars. Dissert. Abstr.

N77-11844 Temple Univ., Philadelphia, Pa.
HOMOGENEOUS COSMOLOGIES WITH STRONG NEUTRINO FIELDS Ph.D. Thesis
Thomas Raymond Michalik 1976 145 p
Avail: Univ. Microfilms Order No. 76-22115

The gravitational field of a single neutrino is investigated in spacetimes which possess the symmetries of spatially homogenous cosmologies. The role of the single neutrino theory within a many neutrino theory is discussed. A brief description of spatially homogenous spacetimes is presented and these spacetimes are analyzed. The Dirac equations for the neutrino and the neutrino stress-energy tensor are obtained in the cosmologic context. A differential equation for the neutrino current, which is equivalent to the Dirac equation, is found, and the neutrino stress energy tensor is expressed entirely in terms of the current and the dyadics. By requiring that the neutrino field be compatible with spatial homogeneity, the spatial dependence of the neutrino wavefunction is determined. This spatial dependence is shown to be directly related to the group structure of the different Bianchi types. Dissert. Abstr.

N77-11845 New Mexico Univ., Albuquerque.
AXIAL XENON REDISTRIBUTION AND POWER SHAPING IN LARGE PRESSURIZED WATER REACTORS Ph.D Thesis
Henrique Francisco Vieira Jorge 1975 215 p
Avail: Univ. Microfilms Order No. 76-22151

The reactor described is aimed at developing an accurate physical model for axial power shaping studies in pressurized water reactors of the current generation. The model is also intended for numerical studies on: (1) reactor load follow capacity throughout a fuel loading lifetime; and (2) burnup dependence of the reactor stability against axial xenon oscillations. The results concern methods development and assessment. A one-dimensional (axial) core geometrical model, coupled with fuel temperature- and moderator coolant thermal-hydraulics-feedback was assembled. Algorithms for computing the feedback effects were developed and incorporated into a general purpose diffusion-theory-depletion computer program (CITATION). The handling of Doppler feedback is based upon the space-dependent average fuel temperature and the functional dependence of fuel nuclide cross sections on the fuel temperature. Dissert. Abstr.

74 OPTICS

Includes light phenomena.

N77-11846 Polytechnic Inst. of New York.
A HIGH PERFORMANCE, LOW COST, DIGITALLY DRIVEN ELECTRON BEAM LITHOGRAPHY SYSTEM Ph.D. Thesis
Mustafa Acar 1976 157 p
Avail: Univ. Microfilms Order No. 76-23390

The design and construction of a high-performance, low cost, digitally driven scanning electron microscope e-beam system is presented. The low cost of the system is achieved by not only constructing a hardware logic system but by also designing the digital drive mechanism around a small computer with an extended casette or disc memory. The input to the computer is obtainable from design programs already being used with the existing optical beam microfabrication techniques. The interface is constructed so that the maximum ease of operation is achieved, where most of the system functions are executed automatically. The set-up is extremely versatile with respect to the resolution, data entering, and speed of operation. Dissert. Abstr.

N77-11847 Polytechnic Inst. of New York.
PERIODIC INTEGRATED OPTICAL STRUCTURES IN PHOTORESIST: APPLICATION TO GRATING COUPLERS Ph.D. Thesis
Stewart Siegmund Austin 1976 144 p
Avail: Univ. Microfilms Order No. 76-23392

A systematic technique is developed for the design and holographic fabrication of periodic structures in photoresist for integrated optical applications. The method is applicable to cases where the resist acts as a mask for further depositions or etchings as well as to situations where the device is fabricated directly in the resist. A model is first presented for fabricating a desired grating by properly adjusting all of the experimental variables available: initial resist thickness, exposure both uniform and holographic, and development time. A method is given for obtaining a suitable initial resist thickness. The etch depth vs. exposure characteristic is determined experimentally for a fixed development time. Whole families of grating profiles are then computer generated by using a polynomial fit to the exposure characteristics. Dissert. Abstr.

N77-11848 Polytechnic Inst. of New York.
DIFFRACTION BY WEDGES AND CONES Ph.D. Thesis
Kuan-Kin Chan 1976 92 p
Avail: Univ. Microfilms Order No. 76-23396

Diffraction fields due to a pulsed electric dipole in the presence of a perfectly conducting wedge are evaluated. It is shown that a previously derived closed form result reduces properly to known solutions in the limiting cases. Finally, the transient dyadic expression for the diffracted fields in closed form is obtained. New representations for the time-dependent scalar and dyadic Green's functions for a perfectly conducting cone are derived. When the angle is small and the source is located on the cone axis the solution can be expressed in remarkably simple forms involving only elementary functions. Also considered are the creeping waves on a perfectly conducting cone. The high frequency asymptotic expressions for the creeping wave fields are derived and cast into a form that can be interpreted in ray optical terms. Dissert. Abstr.

N77-11849 Polytechnic Inst. of New York.
POLARIZATION-INDEPENDENT OPTICAL WAVEGUIDES Ph.D. Thesis
Henry Chaim Oksman 1975 389 p
Avail: Univ. Microfilms Order No. 76-18546

Dielectric optical waveguides are investigated. An attempt to use light as a communication carrier is described. Integrated optical devices, where a laser beam is guided into a thin film structure, and the processing of the signal takes place entirely within the structure, are also studied. Applications where it might be desirable to transmit an unpolarized laser beam are discussed. Several polarization independent waveguide structures are considered. Dissert. Abstr.

N77-11850 Polytechnic Inst. of New York.
MODE PROPERTIES IN UNSTABLE OPTICAL RESONATORS Ph.D. Thesis
Carlos Eduardo Santana 1976 138 p
Avail: Univ. Microfilms Order No. 76-23442

It is shown that the unstable resonator problem can be attacked by a new method whereby the resonator configuration is regarded as a waveguide in the direction transverse to the resonator axis. Guided modes capable of propagating in this waveguide are reflected, transmitted (by radiation) and coupled at the resonator edges, which thus appear explicitly as constituent building blocks in the eigenmode resonance equation. By

postulating a mechanism of selective coupling between two adjacent waveguide modes, it is found possible to produce and explain the intricate interweaving of the resonator eigenmode loss curves, as verified by comparisons with published numerical solutions of the resonator integral equations. Dissert. Abstr.

N77-11851 Colorado Univ., Boulder.
RADIATION AND COUPLING PROPERTIES OF STRAIGHT AND CURVED OPTICAL WAVEGUIDES Ph.D. Thesis
Edward Francis Kuester 1976 251 p
Avail: Univ. Microfilms Order No. 76-23642

Optical waveguides undergo field deformations in the presence of obstacles (such as other waveguides) or when the guide axis varies from straightness. Considered: the coupling between arbitrary modes on parallel optical waveguides of general cross-section, the continuous radiation loss of a mode on a curved guide of general cross section, and the scattering of a mode at the junction between straight and curved sections of a simple surface wave structure. A new variational derivation of the coupling coefficients between arbitrary modes on two or more parallel surface waveguides of arbitrary cross-section is given which permits the attaining of significantly greater accuracy compared to previous techniques. Dissert Abstr.

N77-11852 Polytechnic Inst. of New York.
OPTICAL SURFACE WAVEGUIDE DISCONTINUITIES Ph.D. Thesis
Erh-Wen Hu 1976 111 p
Avail: Univ. Microfilms Order No. 76-23410

The waveguide discontinuity problem is solved by replacing the open structure by a corresponding closed waveguide structure. This reduces the continuous spectrum to a discrete one so that the discontinuity problem can be solved numerically as a function of the distance between the dielectric slab and the perfect metallic enclosure. As the metallic enclosure is moved to infinity, the discrete mode spectrum of the closed structure becomes identical to the modes of the open waveguide and beyond a certain separation, the results change insignificantly with further increases in the separation between the metallic enclosures. The results thus obtained for the radiation losses due to the scattering of surface waves by a step discontinuity agree well with those reported in the literature. Dissert. Abstr.

N77-11853*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE THEORETICAL REFLECTANCE OF X-RAYS FROM OPTICAL SURFACES
John R. Neergaard, John M. Reynolds, and Stanley A. Fields Washington Nov. 1976 55 p refs
(NASA-TN-D-8366; M-195) Avail: NTIS HC A04/MF A01 CSCL 20F

The theoretical reflectance of X-rays from various materials and evaporated films is presented. A computer program was written that computes the reflected intensity as a function of the angle of the incident radiation. The quantities necessary to generate the efficiency and their effect on the data are demonstrated. Five materials were chosen for evaluation: (1) fused silica, (2) chromium, (3) beryllium, (4) gold, and (5) a thin layer contaminant. Fused silica is a versatile and common material; chromium has high reflection efficiency at X-ray wavelengths and is in the middle of the atomic number range; beryllium contains a single atomic shell and has a low range atomic number; gold contains multiple atomic shells and has a high atomic number; the contaminant is treated as a thin film in the calculations and results are given as a function of thickness for selected wavelengths. The theoretical results are compared to experimental data at lambda = 8.34 A. Author

N77-11854# Physical Sciences, Inc., Wakefield, Mass.
INFRARED SIGNATURE MODIFICATIONS, VOLUME 1 Final Report, 1 Jan. 1975 - 31 Jan. 1976
George E. Caledonia Mar. 1976 96 p refs
(Contract F44620-75-C-0039; AF Proj. 6813; AF Proj. 9711)
(AD-A024653; PSI-TR-48-Vol-1; AFOSR-76-0436TR) Avail: NTIS HC A05/MF A01 CSCL 17/5

This report deals with the prediction of non-equilibrium infrared radiation signatures in the wakes of re-entry vehicles. The first section deals with the prediction of non-LTE wake molecular radiation signatures which can result from the injection of small particles into the wakes. GRA

N77-11855# Massachusetts Inst. of Tech., Cambridge. Dept. of Psychology.
EXPERIMENTS IN TEXTURE PERCEPTION Annual Report, 1 Jun. 1974 - 31 May 1975
Whitman Richards Jul. 1975 34 p refs
(Contract F44620-74-C-0076; ARPA Order 2765; AF Proj. 2765)
(AD-A024975; AFOSR-76-0543TR) Avail: NTIS HC A03/MF A01 CSCL 06/16

Visual textures may be described completely by their spatial frequency components. For one-dimensional textures whose luminance varies only along the X-axis of the display, the descriptive elements are gratings that have sinusoidal modulations of luminance. Although any arbitrary 1-dimensional 'blurred' texture may require a large number of sinusoidal components for its complete physical description, only 4 components are needed to create a texture that appears the same to the human observer. The human visual system does not act like a spectral analyser, but rather appears to process spatial frequency information by filtering operations, at least for 1-dimensional texture patterns. In the more general case, textures will have luminance distributions varying in both X and Y dimensions. A new graphics display is being built to test for the minimum number of spatial frequencies required to simulate 2 dimensional texture patterns. The apparatus will permit on-line control of the amplitude (contrast) of the X, Y frequency Fourier components that make up the texture displayed. The observer can generate a texture that appears identical to another having a different and more complex spatial frequency content. If it is found that only 4 spatial frequency components are necessary to simulate all 2-dimensional textures, one may design a scheme to transmit visual information about textures that offers considerable saving in channel capacity. GRA

N77-11856# Lincoln Lab., Mass. Inst. of Tech., Lexington.
OPTICS RESEARCH Semiannual Technical Report, 1 Jul. - 31 Dec. 1975
R. N. Rediker Dec. 1975 29 p
(Contract F19628-76-C-0002; ARPA Order 600)
(AD-A025338; ESD-TR-76-34) Avail: NTIS HC A03/MF A01 CSCL 20/5

Contents: Laser technology and propagation - A. Propagation--(Laboratory experiment on phase correction for thermal blooming, Phase compensation for multiple-pulse thermal blooming, Phase compensation for turbulence, Fog hole boring and propagation study), B. Pollution studies - Atmospheric CO monitoring over long paths in the 1975 regional air pollution study (RAPS) in St. Louis--(Introduction, Site 108 - Granite City, Illinois, Site 105 - Downtown St. Louis, Missouri). GRA

N77-11857# Arizona Univ., Tucson. Optical Sciences Center.
EIGHT-YEAR APPLIED OPTICS RESEARCH REPORT Final Report, Nov. 1967 - Jan. 1975
Oct. 1975 74 p refs
(Contract F04695-67-C-0197)
(AD-A025340; SAMSO-TR-76-110) Avail: NTIS HC A04/MF A01 CSCL 20/6

The formative period of the Optical Sciences Center is described beginning with the initial discussions of the need for a new research facility and culminating with a listing of the faculty members and the current areas of research presently under way. A listing of graduates from the Optical Sciences Center is presented, and the publications completed under contract F0 4695-67-C-0197 are listed. GRA

N77-11858# RCA Labs., Princeton, N.J.
CHARGE COUPLED SCANNED IR IMAGING SENSORS Semiannual Report, 1 May - 30 Oct. 1975
Elliott S. Kohn and R. D. Larrabee 14 Nov. 1975 25 p ref
(Contract F19628-73-C-0282; ARPA Order 2444)
(AD-A025224; PRRL-75-CR-67; AFCRL-TR-75-0624; SR-4)
Avail: NTIS HC A02/MF A01 CSCL 17/5

The ultimate goal of this work is the fabrication of a two-dimensional infrared imager. The authors previous work with the 64 x 1 line array has proven the feasibility of the

Schottky-barrier detector silicon/CCD system, and has, in the vidicon mode, demonstrated a uniformity approaching that needed for thermal imaging. In the present work, the two-dimensional imager is being designed and fabricated. The first arrays will again have palladium-silicide on p-silicon as the detector system, but subsequent arrays will be made with platinum-silicide for deeper IR response. A line array is also included on the chip to provide additional features. The considerations that have gone into the design are discussed below. Quantitative infrared measurements have already begun and have yielded good agreement with previous measurements on the absolute quantum efficiency of PdSi:p-Si detectors. GRA

N77-11244# Ruhr Univ., Bochum (West Germany).
CURRENT PROBLEMS OF OPTICAL INTERFEROMETRY USED IN EXPERIMENTAL GAS DYNAMICS
Wolfgang Merzkirch *In* AGARD Appl. of Non-Intrusive Instr. in Fluid Flow Res. May 1976 11 p refs (For primary document see N77-11221 02-31)
Avail: NTIS HC A14/MF A01

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N77-11859 Colorado Univ., Boulder.
TRANSPORT PROCESSES WITHIN A PLASMA DRIVEN BY A HIGH-FREQUENCY ELECTRIC FIELD Ph.D. Thesis
Dean Elwood McKinnis 1976 91 p
Avail: Univ. Microfilms Order No. 76-23639

A method is described for calculating transport coefficients within a plasma driven by a high frequency alternating electric field. The method involves a collision term expressed in the Klimontovich form, and does not require the field to be weak. Representative calculations are made for a nonrelativistic, nondegenerate, two-component, magnetic field-free plasma by using a large number functional form to simplify some sums over wave number; expressions are derived for thermal conductivity, electron resistive heating rate, and interspecies heat exchange rate as functions of electric field strength. Numerical values are given for the three functions. Dissert. Abstr.

N77-11860 Syracuse Univ., N.Y.
SECOND HARMONIC GENERATION IN A BOUNDED MAGNETOPLASMA Ph.D. Thesis
Donald Gary Thomas 1975 83 p
Avail: Univ. Microfilms Order No. 76-18567

Second harmonic generation was considered for a magnetized plasma contained in a cylindrical cavity resonator. It is shown how the harmonic power varies with fundamental power, background gas pressure, and magnetization. Two cavities were designed. For each the TM010 resonance was in the S-band and the TM011 resonance in the C-band. Both frequencies were harmonically related when the d.c. discharge sustaining the plasma was adjusted to give plasma frequencies of approximately 0.7 GHz and 1.53 GHz. The experimental results show the harmonic power approximately proportional to the square of the fundamental power from 5 to 100 mw, and a decreasing function of pressure from 10 to 150 millitorr. Experiments at constant plasma frequency and varying magnetic field from 0 to 3,000 Gauss show a sharp drop in harmonic power to undetectable levels when the electron cyclotron frequency approximates either the fundamental or second harmonic frequencies. Dissert. Abstr.

N77-11861 Polytechnic Inst. of New York.
AN EXPERIMENTAL AND THEORETICAL STUDY OF THE PROPAGATION OF HIGH AMPLITUDE PULSES IN A BOUNDED MAGNETO-PLASMA Ph.D. Thesis
Erich Enrique Kunhardt 1976 123 p
Avail: Univ. Microfilms Order No. 76-23421

The propagation of narrow, high amplitude pulses along a plasma column has been studied. The evolution of the pulse in space-time has been observed as a function of initial pulse strength. This technique gives insight into the competitive effects due to dispersion and nonlinearities. For a plasma, the positive column of a hot cathode discharge in Argon is used. At each operating point, i.e., for a given pressure and discharge current, recordings were obtained for different values of excitation pulse amplitude and background static magnetic field. For zero static magnetic field, two types of recordings were taken. For the first type, the position of the receiver was fixed and oscillograms in time were recorded. In the second type, the sampling time is kept fixed, and the receiving probe is moved along the column. The oscillograms showed that the dispersion is negative and that the group velocity increases with plasma density. As the amplitude of the input pulse is increased, nonlinear effects start to play a role. Dissert. Abstr.

N77-11862 Princeton Univ., N.J.
ON RENORMALIZED KINETIC THEORIES OF ANOMALOUS TRANSPORT DUE TO HYDRODYNAMIC FLUCTUATIONS IN STRONGLY MAGNETIZED PLASMA Ph.D. Thesis
John Albert Krommes 1975 300 p
Avail: Univ. Microfilms Order No. 76-22601

The theory of hydrodynamic fluctuations in thermal equilibrium magnetized plasma is considered. A renormalized version of Williams' cumulant hierachy for two-time fluctuation correlation functions is proposed which includes explicitly the nonclassical effects of low frequency, long wavelength hydrodynamic fluctuations. Rigorous projection operator expressions for the transport coefficients which describe the regression of the fluctuations are given. Both the fluid transport coefficients and the test particle diffusion coefficient are discussed. The general formalism is then applied to the specific case of ion shear viscosity in strongly magnetized 2-D plasma. The classical transport is dominated by the convective effects due to the nonlinear coupling of ion shear modes. Dissert. Abstr.

N77-11863 Colorado Univ., Boulder.
PUMP WAVENUMBER DEPENDENT EFFECTS IN THE PARAMETRIC INSTABILITIES OF A PLASMA Ph.D. Thesis
Steven Jack Bardwell 1976 155 p
Avail: Univ. Microfilms Order No. 76-23587

A linear kinetic theory of parametric instabilities in an infinite homogeneous, fully ionized plasma, with no magnetic field is derived. The derivation relaxes three assumptions usually made in the linear theory of certain parametric instabilities: (1) it is not assumed that the wavenumber of the pump is much smaller than any other inverse distance in the plasma; (2) growth of the instability is not restricted to one dimension; and (3) a standing-wave pump is considered in addition to the usual travelling wave pump. Using this generalized formalism, the important problem of the parametric instabilities, in three dimensions, pumped by a monochromatic, longitudinal pump of arbitrary wavevector was studied. Dissert. Abstr.

N77-11864# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.
NONSTATIONARY ANALYSIS OF OHMIC AND VISCOUS HEATING OF A CYLINDRICAL PLASMA SHELL
D. Ohlsson 20 Sep. 1975 27 p refs
(TRITA-EPP-75-19) Avail: ERDA Depository Libraries HC $4.00

Possible heating mechanisms for a cylindrical plasma shell confined in an axial magnetic field are investigated. Two different cases are studied, namely ohmic and viscous heating of a rotating plasma and ohmic heating of a static plasma. The nonstationary plasma fluid equations are solved by using a numerical code. Primary interest was in the maximum temperatures obtained by ohmic heating of a static plasma. It is shown that, in the first classical approximation, it is possible to reach temperatures at plasma densities, magnetic field strengths and induced current. Author

N77-11865# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
VELOCITY LIMITATIONS IN COAXIAL PLASMA GUN EXPERIMENTS WITH GAS MIXTURES
Ingvar Axnaes Apr. 1976 25 p refs Sponsored by Swed. Atomic Res. Council
(TRITA-EPP-76-02) Avail: NTIS HC A02/MF A01

The velocity limitations found in many crossed field plasma experiments with neutral gas present were studied for binary mixtures of H2, He, N2, O2, Ne, and Ar. The apparatus used was a coaxial plasma gun with an azimuthal magnetic bias field. The discharge parameters were chosen so that the plasma was weakly ionized. In some of the mixtures it was found that one of the components tends to dominate in the sense that only a small amount (regarding volume) of that component is needed for the discharge to adopt a limiting velocity close to that for the pure component. Thus in a mixture between a heavy and a light component having nearly equal ionization potentials the heavy component dominates. Also if there is a considerable difference in ionization potential between the components, the component with the lowest ionization potential tends to dominate. Author (ESA)

N77-11866# Visidyne, Inc., Burlington, Mass.
A STUDY OF X-RAY EMISSION FROM LASER HEATED PLASMA Final Report, 4 Apr. 1973 - 31 Mar. 1974
O. P. Manley and R. E. Waltz 26 Mar. 1974 45 p refs
(Contract DNA001-73-C-0177; DNA Proj. NWED-QAXPF001) (AD-A025498; VI-231; DNA-3597F) Avail: NTIS HC A03/MF A01 CSCL 20/9

This document is a final report on the investigation of laser-plasma interactions leading to pulsed X-ray emission. In the course of this research two topics were looked into in some detail. First, the authors evaluated and found promising a method for efficient laser heating of a turbulent plasma column generated in a double inverse pinch experiment. The results obtained in this ongoing experimental effort, supported primarily by AFOSR, show that the heating method suggested herein leads to a feasible source of intense X-ray pulses. Secondly, the authors looked into effects to be expected when extremely intense laser beams interact with dense plasmas. It was found that under these conditions relativistic effects will lead to intense collimated pulses by synchrotron-like emissions of radiation in the 10 kev region. GRA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N77-11867 Massachusetts Univ., Amherst.
PLANE SHOCK WAVES IN QUANTUM GASES AT VERY LOW TEMPERATURES Ph.D. Thesis
Lorraine Irene Rzonca 1976 166 p refs
Avail: Univ. Microfilms Order No. 76-22297

The proposed shock model, a quantum analog of the classical approach, attempts to describe the effects due to strong shocks passing through an elementary particle quantum gas of any given degree of degeneracy. This model is used to calculate shock thicknesses in helium gas for various Mach numbers and for a wide range of degeneracy. Significant differences between normal helium, He-4 (obeying Bose-Einstein statistics), and the isotope, He-3 (obeying Fermi-Dirac statistics), are evident. Dissert. Abstr.

N77-11868 Syracuse Univ., N.Y.
THE EPITAXIAL GROWTH OF THIN FILMS AND THE INTERFACIAL DISLOCATIONS STUDIED BY RHEED AND TRANSMISSION ELECTRON MICROSCOPY Ph.D. Thesis
Cheng Tzong Horng 1975 204 p
Avail: Univ. Microfilms Order No. 76-18522

Thick continuous Cu films, 900 to 1200 A thick, were deposited simultaneously in high vacuum on three different monocrystalline NaCl substrates: evaporated NaCl on mica, evaporated (100) NaCl and air cleaved (100) NaCl. The occurrence and microstructure of monocyrstalline or polycrystalline Cu films were determined by TEM and TED as a function of deposition rate R and substrate temperature T. Activation energies for the polycrystalline to monocrystalline transition of Cu films were calculated to be 1.48, 1.22 and 1.27 eV for the evaporated (111), (100) and air cleaved (100) NaCl substrates respectively. Results indicate that both the binding energy between a single adatom and a growing oriented cluster and the atomic adsorption energy on the substrate surface are proportional to the planar densities in the growing cluster and in the substrate surface respectively. Dissert. Abstr.

N77-11869 Polytechnic Inst. of New York.
BEAM PROPAGATION AND GUIDING IN ANISOTROPIC MEDIA, LAYERS AND FIBERS Ph.D. Thesis
Sang-Yung Shin 1976 160 p
Avail: Univ. Microfilms Order No. 76-23446

The complex source point method eliminates the need for spectral decomposition of an impressed Gaussian profile. This method is developed for the study of beam propagation in an anisotropic medium, and utilized extensively to examine problems pertaining to the excitation of dielectric layers wherein the extension of the complex source point method to an inhomogeneous medium is performed. The method is employed to study Gaussian beam tracking and guided mode excitation by a Gaussian beam in an optical fiber. Concerning the anisotropic case, the complex source point method, is first established for media with arbitrary anisotropy, with emphasis on asymptotic descriptions in the paraxial regime. Detailed consideration is then given to the special case of a uniaxially anisotropic medium, for which point and line source solutions are available in closed form. Dissert. Abstr.

N77-11870 Cornell Univ., Ithaca, N.Y.
NONLINEAR OPTICAL PROPERTIES AND CRYSTAL GROWTH OF II-IV-V2 CHALCOPYRITE SEMICONDUCTORS Ph.D. Thesis
Frederick William Scholl 1976 136 p
Avail: Univ. Microfilms Order No. 76-18202

Two separate areas of the chalcopyrite material technology are studied: theory of nonlinear optical properties, and crystal growth and characterization of ZnGeAs2. Our theoretical investigation of the nonlinear optical properties led to the first ab initio calculation of the nonlinear optical susceptibility of the II-IV-V2 materials. Good agreement with experiment was obtained. A molecular orbital model was used, in which the nonlinearity was attributed to the hyperpolarizability of independent chemical bonds. Experimental work on ZnGeAs2 resulted in growth of the first single crystals of this material and accurate measurement of the fundamental bandgap. Dissert. Abstr.

N77-11871 Rice Univ., Houston, Tex.
STATIC MAGNETIC PROPERTIES OF DC BIASED RF SPUTTERED GdFe AMORPHOUS FILMS Ph.D. Thesis
Robert Zwingman 1976 94 p
Avail: Univ. Microfilms Order No. 76-21730

The room temperature magnetic properties of bias-sputtered Gd sub 1-x Fe sub x films are reported. A number of low magnetization films made under various d.c. substrate bias conditions are compared. Factors discussed include: magnetic domain wall energies; strip periods; coercivity; anisotropy; and exchange constants. The static magnetic properties of these films are used to evaluate bias-sputtered GdFe films as a possible bubble domain device material. Dissert. Abstr.

N77-11872 Polytechnic Inst. of New York.
IONIC CONDUCTIVITY IN THE SODIUM GALLATES Ph.D. Thesis
Richard Julian Chicotka 1976 102 p
Avail: Univ. Microfilms Order No. 76-23400

The gallium analogs of the sodium beta-aluminas show excellent properties for use as solid electrolytes, exhibiting high values of ionic conductivity and a low value for the activation energy. Substantial increases in the ionic conductivity of the sintered ceramics are possible with optimized samples or with phase stabilizing additions such as lithia and magnesia. Dissert. Abstr.

N77-11873 California Inst. of Tech., Pasadena.
PULSE NMR IN SOLIDS: CHEMICAL SHIFT, LEAD FLUORIDE AND THORIUM HYDRIDE Ph.D. Thesis
Kei-Fung Lau 1976 104 p
Avail: Univ. Microfilms Order No. 76-23111

The fluorine chemical shift of a single crystal CaF2 has been measured as a function of external pressure up to 4 kilobar at room temperature using multiple pulse NMR techniques. The

pressure dependence of the shift is found to be -1.7 + or - 1 ppm/kbar, while a theoretical calculation using an overlap model predicts a shift of -0.46 ppm/kbar. A separation of the chemical shift tensor into physically meaningful geometrical and chemical contributions is presented. A comparison of the proposed model calculations with recently reported data on hydroxyl proton chemical shift tensors demonstrates, that for this system, the geometrical portion accounts for the qualitative features of the measured tensors. Dissert. Abstr.

N77-11874 North Texas State Univ., Denton.
A CLASSICAL THEORY OF THE DIELECTRIC SUSCEPTIBILITY OF ANHARMONIC CRYSTALS Ph.D. Thesis
Howard Vernon Kennedy 1976 167 p
Avail: Univ. Microfilms Order No. 76-23762

An expression for the dielectric susceptibility tensor of a cubic ionic crystal has been derived using the classical Liouville operator. The effect of cubic anharmonic forces is included as a perturbation on the harmonic crystal solution, and a series expansion for the dielectric susceptibility is developed. The most important terms in the series are identified and summed, yielding an expression for the complex susceptibility with an anharmonic contribution which is linearly dependent on temperature. A numerical example shows that both the real and imaginary parts of the susceptibility are continuous, finite functions of frequency. Dissert. Abstr.

N77-11875 Lehigh Univ., Bethlehem, Pa.
A PHOTOCURRENT SPECTROSCOPIC METHOD FOR DETERMINATION OF TRAPPING STATE DISTRIBUTIONS IN SILICON DIOXIDE THIN FILMS Ph.D. Thesis
Vikram Jeet Kapoor 1976 188 p
Avail: Univ. Microfilms Order No. 76-21814

The energy and spatial distributions of electrons trapped in the silicon dioxide film of a metal oxide semiconductor structure during internal photoemission have been determined. Photodepopulation and electrical characteristics measurements have been used to measure the spatial distribution through a series of etching steps. The impurity and/or structural imperfection responsible for the 2.4-2.5 eV deep electron trapping levels was found to be uniformly distributed throughout the oxide volume. The fixed electronic charge was found to have a significant excess at the interfaces. Dissert. Abstr.

N77-11876 South Dakota School of Mines and Technology, Rapid City.
THERMAL CONDUCTIVITY OF HEAVILY DOPED P-TYPE INDIUM ANTIMONIDE Ph.D. Thesis
Chia Yi Hsiung 1976 121 p
Avail: Univ. Microfilms Order No. 76-23269

Thermal conductivity, thermoelectric power, and electrical resistivity were measured from 5 K to 300 K on three heavily doped InSb samples containing 2.51 x 10 to the 19th power, 2.55 x 10 to the 19th power, and 3.55 x 10 to the 19th power acceptors per cu cm. For thermal conductivity measurement, the linear absolute method was used. The thermoelectric power and electrical resistivity results were used to assist the interpretation of the thermal conductivity observations. The analysis of the thermal conductivity was carried out in terms of Holland's relaxation-time formulation and Hamilton and Parrot's variational model. Three-phonon, impurity, boundary, and hole-phonon scattering mechanisms were included in the analysis. The results show that the relaxation time method produced a better fit to the experiment than the variational method. Dissert. Abstr.

N77-11877 North Texas State Univ., Denton.
QUANTUM SIZE OSCILLATIONS AND SIZE EFFECTS Ph.D. Thesis
John Robert Garlow 1976 79 p
Avail: Univ. Microfilms Order No. 76-23755

The quantum-mechanical magnetoconductivity tensor for a thin metal sample is calculated with linear response theory. In that theory the response of a free electron gas to an electromagnetic disturbance is assumed to be linear. In addition, it is assumed that each Fourier component of the disturbance gives rise to an independent response. The Hamiltonian for one electron is then written as the sum of an unperturbed part and a perturbation due to the electromagnetic disturbance. The equation of motion for the one particle density matrix is used to obtain the response of the system. The rate of change of the density matrix due to collisions is taken into account by the use of constant relaxation time approximation. To apply this theory to a thin film, the stationary states of the system are assumed to be those of an electron in a magnetic field and an infinite square well potential with Landau energy levels described by quantum numbers for the magnetic field and the z-component of momentum. Dissert. Abstr.

N77-11878 Clarkson Coll. of Technology, Potsdam, N.Y.
ELECTRICAL TRANSPORT PROPERTIES OF ITINERANT AND LOCALIZED ELECTRON MAGNETIC SYSTEMS Ph.D. Thesis
Tice Floyd DeYoung 1976 174 p
Avail: Univ. Microfilms Order No. 76-22487

Electrical resistivity studies as a function of temperature in the range from 50 to 1000 K are presented for Cr-Ir and Cr-Ru alloys, thermo-electric power between the temperature region (350-1000 K) and electrical resistivity measurements below 350 K on Gd-Sm samples for Sm content every 5% up to pure Sm. The investigations on Cr alloys show that the Neel temperature increases with increasing diluent, then remains approximately the same for several percent and then rapidly decreases. The size of the resistivity anomaly, however, reaches its maximum value when T sub N is decreasing with increasing concentration of diluent. The Gd-Sm experiments have shown that a simple ferromagnetic structure is present up to about 45% Sm. For about 15-20% above this, there is a complicated magnetic structure in which the ferromagnetic and antiferromagnetic phases are competing with each other. Dissert. Abstr.

N77-11879 Pennsylvania Univ., Philadelphia.
MICROWAVE RESPONSE OF NONEQUILIBRIUM SUPERCONDUCTORS Ph.D. Thesis
ChengChung John Chi 1976 184 p
Avail: Univ. Microfilms Order No. 76-22669

Microwave reflection from a superconducting thin film was used as a probe to measure the changes of quasiparticle population and the gap parameter of a superconducting film. The nonequilibrium state of the superconducting film was produced by a pulsed laser irradiation. The rise time and fall time of the laser pulse produced by a GaAs injection laser are shorter than 1 nanosec. The light power can vary over four orders of magnitude. For a small perturbation, the change of the gap parameter is proportional to the change of the quasiparticle population. Therefore, the decay time constant of the microwave reflectivity signal essentially measures the recombination lifetime of the quasiparticles. Within the limitation of our equipment resolution time, which is about 23 nanosec., this goal was achieved for Al fields. Dissert. Abstr.

N77-11880 Lowell Univ., Mass.
FAR-INFRARED RECOMBINATION RADIATION FROM IMPACT-IONIZED SHALLOW DONORS IN n-TYPE GaAs IN HIGH MAGNETIC FIELDS Ph.D. Thesis
Tung-Shan Chang 1976 118 p
Avail: Univ. Microfilms Order No. 76-23571

The far infrared emission spectra of high purity, epitaxial, n-GaAs was obtained. The radiation was generated by impact ionizing samples immersed in liquid helium with the application of voltage pulses sufficient to cause avalanche breakdown. The emission spectra were studied principally at high magnetic fields ranging from 60 to 100 kilogauss. Radiative recombination between adjacent Landau levels was observed for the first time in GaAs and is the dominant feature in the spectra at high magnetic fields. Additional lines in the emission spectra were found to be due to radiative recombination between localized donor impurity states. The relative intensities of Landau level emission and that from the 2P states can be understood in terms of the much larger density of Landau states. The zero magnetic field spectra was also obtained and compared with previous data. Dissert. Abstr.

N77-11881 Polytechnic Inst. of New York.
FIELD EFFECT IN FERROMAGNETIC METALS Ph.D. Thesis
Purabi Mazumder 1976 133 p
Avail: Univ. Microfilms Order No. 76-23431

The metallic field effect (MFE) was studied in thin films of permalloy, with compositions 10% and 20% iron in nickel, as a function of the magnitude and direction of an applied magnetic field in the plane of the film. The film acts as one electrode of a parallel plate condenser, with mica as the dielectric. An ac charge applied to the film gives a small modulation of its conductance Phase, and frequency sensitive detection techniques are used to measure the changes in conductance. Dissert. Abstr.

N77-11882 Lehigh Univ., Bethlehem, Pa.
ONE-ELECTRON ENERGY BANDS OF SILICON DIOXIDE IN THE IDEAL BETA CRISTOBALITE STRUCTURE Ph.D. Thesis
Philip Michael Schneider 1976 287 p
Avail: Univ. Microfilms Order No. 76-21831

The mixed basis method, which utilizes Bloch sums of nonoverlapping atomic-like functions and symmetrized combinations of plane waves, is used to calculate energy bands of SiO2 in ideal beta cristobalite, a dimond structure with an oxygen lying midway between each pair of nearest neighbor silicons. The crystal potential is taken as a sum of atomic silicon and oxygen potentials, obtained by solving the atomic Hartree-Fock-Slater equations. No adjustable parameters or artificial muffintin potentials, difficult to justify in an open solid such as SiO2, are required. It was found that the SiO2 band structure is basically that of an ionic crystal with the presence of covalent bonding states. Dissert. Abstr.

N77-11883 Rice Univ., Houston, Tex.
THE THERMODYNAMICS AND KINETICS OF INTERSTITIAL SOLID SOLUTIONS Ph.D. Thesis
Jose Roberto Goncalves Dasilva 1976 81 p
Avail: Univ. Microfilms Order No. 76-21671

The following topics are considered: (1) Thermodynamics of the hydrogen-iron system; (2) solubility of hydrogen in superpure iron single crystals; (3) thermodynamic functions of hydrogen in solid solutions of the group V metals niobium, tantalum and vanadium; (4) diffusion of carbon and nitrogen in BCC iron; amd (5) solubility of hydrogen in alpha-manganese. Dissert. Abstr.

N77-11884# Hanford Engineering Development Lab., Richland, Wash.
GRAIN BOUNDARY STRUCTURES AND ENERGIES IN fcc-IRON
R. D. Bourquin Jul. 1975 28 p refs Presented at Conf. on Computer Simulation for Mater. Appl., Gaithersburg, Md., 19-20 Apr. 1976; sponsored by Nucl. Met. Comm. of the Am. Inst. of Met. Engr. and NBS Sponsored by ERDA
(HEDL-SA-1002; Conf-760421-1) Avail: NTIS HC A03/MF A01

The structures and energies of grain boundaries in an fcc model metal intended to represent gamma-iron are presented. Symmetric and asymmetric tilt boundaries in the low index planes (100), (110), and (111) are studied. Low angle tilt boundaries are studied for each orientation of the lattice face planes since their structures can be represented by edge dislocation arrays, and their energies can be described by the Read-Shockley formula. High angle tilt boundaries having structures that can be simulated by arrays of cavity defects and whose energies are not adequately described by the Read-Shockley formula are studied as companion cases. Discrete lattice theory is utilized in quasi-dynamic and dynamic modes of computer experimentation. Most of the studies are generated using a symmetric nearest neighbor interatomic potential function, but in some cases the energies and structures are compared with those calculated using a noncentral potential function so that the sensitivity of structure and energy to the type of interatomic potential function used can be seen. ERA

N77-11885# Reactor Centrum Nederland, Petten.
CRITICAL POINTS IN MAGNETIC SYSTEMS, A NEUTRON DIFFRACTION STUDY OF CsCoCl32D2O
A. L. M. Bongaarts Dec. 1975 141 p refs
(RCN-235) Avail: ERDA Depository Libraries HC $6.00

A review is given of the present phenomenological theories of critical points in terms of the scaling, the universality, and the smoothness hypothesis. The experimental part describes an investigation by means of thermal neutron scattering to the magnetic phase transitions in the metamagnet CsCoCl3.2D2O, T/sub N/ = 3.30-0 K. Along the line of critical points, that separates the antiferromagnetic region from the paramagnetic region in the HT-phase diagram, the critical behavior is found both qualitatively and quantitatively in agreement with the predictions of the smoothness hypothesis. A tricritical point is located at T/sub t/ = 1.85-0 K and H/sub t/ = 2.70 kOe, and a full set of tricritical exponents is obtained. It is demonstrated that these exponents are in agreement with the predictions of the scaling hypothesis at a tricritical point, but differ from the classical exponents predicted by recent renormalization group techniques. ERA

N77-11886# National Bureau of Standards, Washington, D.C.
ON THE ANGULAR DIVERGENCE OF OUT-GOING BEAMS IN AN ASYMMETRIC DIFFRACTION GEOMETRY Final Report
Masao Kuriyama and William J. Boettinger Dec. 1975 3 p refs Repr. from Acta Cryst. (Denmark), v. A32, part 3, May 1976 p 511-512 Submitted for publication
(PB-255865/8) Avail: NTIS HC A02/MF A01 CSCL 20B

The well known relation for the angular divergence of X-ray beams diffracted from a perfect crystal in an asymmetric diffraction condition is derived straightforwardly from first principles. (GRA)

N77-11887# California Univ., La Jolla. Dept. of Physics.
KKR ANALYSIS OF THE ANDERSON-MCMILLAN THEORY OF ELECTRONIC STRUCTURE OF LIQUID METALS
J. J. Olson Apr. 1976 18 p refs
(Contract N00014-76-C-0050; NR Proj. 017-653)
(AD-A024386; TR-35) Avail: NTIS HC A02/MF A01 CSCL 07/4

The method of Anderson and McMillan (AM) has recently been demonstrated to fail for resonant scatterers while nevertheless providing a useful bandstructure approximation for non-resonant scatterers. The authors explain this behavior by using the formalism of Korringa, Kohn, and Rostoker (KKR) to relate the AM method to well known approximations in the band theory of crystalline solids. In particular the authors show that the AM method for the dispersion relation of a liquid metal is essentially an optimized single-orthogonalized-plane-wave approximation to the bandstructure of a crystal at the same density. GRA

N77-11888# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
MOLECULAR CLUSTERS AND CATALYTIC ACTIVITY Interim Report
K. H. Johnson Mar. 1976 42 p refs
(Contract N00014-75-C-0970; NR Proj. 056-596)
(AD-A024349; TR-2) Avail: NTIS HC A03/MF A01 CSCL 07/4

Recent applications of quantum chemistry, with emphasis on applications of the SCF-X-alpha-SW method, to molecular clusters and catalytic activity are reviewed. Author (GRA)

N77-11889# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
INVESTIGATION OF ELECTRONIC TRANSPORT, RECOMBINATION AND OPTICAL PROPERTIES IN In As sub 1-X P sub X ALLOY SYSTEMS Final Report, Dec. 1973 - Apr. 1976
Sheng S. Li 1 May 1976 145 p refs
(Contract DAAK02-74-C-0102; ARPA Order 2182)
(AD-A025294) Avail: NTIS HC A07/MF A01 CSCL 20/12

An experimental study was made of the transport properties of InAs grown epitaxially from the vapor phase onto semi-insulating GaAs substrates. The hydrogen carrier gas flow rate was varied for four sets of samples of InAs with changing thickness between sets. A fifth set was investigated with varying composition. Resistivity and Hall effect measurements from 3K to 300K yield electron mobilities as high as 13,100 sq cm volt-sec at 77K and electron concentrations from 5 x 10 to the 16th power/cu cm to 8 x 10 to the 16th power/cu cm at 300 K. Transport at low temperature is attributed to the formation of a donar impurity band. Optical transmission measurements and electron microprobe analyses were made on bulk InAs samples of different compositions. Absorption coefficient as a function of wavelength near the fundamental absorption edge was deduced

from transmission data. Energy band gap versus alloy composition was determined for these samples. Surface photovoltage technique was employed to determine the hole diffusion length on three n-type InP specimens with (111) and (100) orientations. The measured hole diffusion length was found to be independent of the surface conditions. Author (GRA)

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N77-11890 Brigham Young Univ., Provo, Utah.
THERMODYNAMIC STUDY OF METAL ION-MACROCYCLIC LIGAND INTERACTION Ph.D. Thesis
Ronald Ellis Terry 1976 307 p
Avail: Univ. Microfilms Order No. 76-23729

The interaction between several uni- and bivalent cations and 15 macrocyclic and linear polydentate ligands was studied in methanol water solvents using a calorimetric titration procedure. Log K sub i, Delta H sub i, and Delta S sub i values are reported for those reactions which produced sufficient heat to allow their calculations. The influence of cation and ligand parameters and solvent dielectric constant on log K sub i, Delta H sub i, and Delta S sub i was investigated. A computer program is presented which is able to compute and plot species distributions and thermograms for various reaction reaction schemes. An equation based on presumed electrostatic interactions between a charged sphere and point dipoles is also presented. The model enables the prediction of observed trends in log K values with changes in cation and ligand parameters and solvent dielectric constant. Dissert. Abstr.

N77-11891 Polytechnic Inst. of New York.
CONTRIBUTIONS TO WKB THEORY Ph.D. Thesis
Edward Thomas Siebert 1976 220 p
Avail: Univ. Microfilms Order No. 76-23447

New forms of the WKB quantization rule have been developed. When these rules are used the eigenvalues obtained are exact, not approximate. Of equal importance, when these eigenvalues are used in the correct WKB series expansion, the series is convergent, not asymptotic. Because the series is not asymptotic it will converge in the region of the classical turning points. No connection formulas are required. Also developed were several techniques for improving the convergence of the series when it is used in the quantization contour integral. The residues due to poles can be eliminated from all but a finite number of terms. Dissert. Abstr.

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N77-11892*# Ross (S.) and Co., Boston, Mass.
A STUDY OF THE REMOTE NEIGHBORHOOD OFFICE CENTER CONCEPT Final Report
31 Aug. 1976 103 p refs
(Contract NASw-2743)
(NASA-CR-149190) Avail: NTIS HC A05/MF A01 CSCL 05A

The substitution of communications for commuting to work is examined from several aspects. Attention is focused on the possibility of certain groups of white collar workers conducting their business affairs through a network of Remote Neighborhood Office Centers (RNOC's) located near their homes. Typically, employees would communicate with their headquarters organizations by means of voice and digital circuits. Although current technology is readily able to support such an RNOC network, the main problems confronting would-be implementers center around the need for demonstrating that a sufficient number of business operations can be carried out in such a decentralized configuration as efficiently as they are under more conventional circumstances. The description of a pilot program is presented which is intended to identify pacing issues that must be settled before firm conclusions can be reached on whether the concept is operationally viable. Author

N77-11893# Grumman Aerospace Corp., Bethpage, N.Y. Command Support Systems Group.
EXPERIMENTAL EVALUATION OF AN OPTIONS SELECTION MATRIX AS AN OPERATIONAL DECISION AID Technical Report, 1 Jul. 1975 - 31 Mar. 1976
C. R. Kalenty and W. L. Lockwood Mar. 1976 113 p
(Contract N00014-75-C-0980)
(AD-A023889; CSS-76-3) Avail: NTIS HC A06/MF A01 CSCL 05/10

This study was both to identify the relevant factors associated with an operational decision and to investigate experimentally the efficacy of decision aids as a function of the level of computer support provided to the commander. An operational decision involving the selection of a tattletail ship was chosen as the decision point for evaluation and an experiment was designed and validated using an options selection matrix as the decision aid. Nine subjects with command support experience and/or operational Naval experience were tested in our Command Support Simulator to evaluate the acceptance of three distinct levels of computer support in arriving at a selection of a tattletail ship. Author (GRA)

N77-11894# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. PRAM Program Office.
PROJECT SCREENING Final Report
Gordon W. Spray 15 Oct. 1976 36 p
(AD-A023837; ASD/RAXA-76-5) Avail: NTIS HC A03/MF A01 CSCL 05/1

The effective handling of ideas for potential PRAM projects requires a screening process that considers multiple factors. The mechanization of this process, while it is not a mandatory requirement, is definitely a practical necessity. The applicability of this screening methodology and computer design is demonstrated, including several types of computer output printouts and screening worksheets. GRA

N77-11895# Army War Coll., Carlisle Barracks, Pa.
APPLICATION OF PRINCIPLES OF ORGANIZATIONAL STRUCTURE TO HIGH TECHNOLOGY ACTIVITIES
Thomas G. Evans 20 Oct. 1975 27 p refs
(AD-A024012) Avail: NTIS HC A03/MF A01 CSCL 05/1

The objective of this paper is to provide information about principles of organizational structure as they apply to high technology activities. To acquire background about these principles, an extensive review of the literature was conducted. Those principles that seemed most generally applicable were selected for analysis. The review of the literature demonstrated that merely listing and analyzing the most applicable principles would not adequately satisfy the objective of the paper. It was obvious that human behavioral and system concepts of organization, which are not readily expressed as principles, must be included in order to provide a balanced development of the objective. Thus, this paper lists and analyzes the most applicable principles of organizational structure. Additionally, it discusses human behavioral and systems concepts of organization and, where possible, expresses these concepts as principles. Three major conclusions come from the analysis that was conducted. The first is that principles of organizational structure must be

applied in a flexible manner. The second is that traditional principles, to a great degree, continue to apply to high technology activities. The third conclusion is that human behavioral and systems concepts have increased application in high technology activities. Author (GRA)

N77-11896# Air Force Academy, Colo.
A CONCEPTUAL MODEL FOR EVALUATING CONTRACTOR MANAGEMENT DURING SOURCE SELECTION Final Report
F. Theodore Helmer and Robert L. Taylor Mar. 1976 54 p refs
(AD-A023817; USAFA-TR-76-6) Avail: NTIS HC A04/MF A01 CSCL 05/1

The evaluation model in this report is not a definitive outline of what must be done during source selection; it is, rather, a discussion of a number of the variables that ought to be considered. One can then include only those variables relevant to the task at hand. The model should be viewed as a thought-triggering device for source selection panels to define and structure contractor management evaluation during the source selection process. The evaluation of contractor management is divided into major functional areas: planning, organizing, and controlling. A checklist of variables under each topic is included, with examples of a numerical scoring system, a color-coded evaluation system, and a descriptive adjective evaluation system. The report concludes with a detailed example of a complete source selection numerical scoring system, including technical, cost, management, quality, reliability, experience, facilities, and contract evaluations. GRA

N77-11897# California State Univ., Los Angeles.
PROGRAM EVALUATION AND REVIEW TECHNIQUE (PERT): A PLANNING AND CONTROL TOOL FOR OCCUPATIONAL FIELD STUDIES
John M. Hemphill, Jr., Harold C. Stone, and Dale Yoder Sep. 1975 59 p refs Sponsored in part by the US Marine Corps, Washington, D. C.
(Contract N00014-74-A-0436-0001; NR Proj. 151-370; RR0420402)
(AD-A024131; TR-3) Avail: NTIS HC A04/MF A01 CSCL 05/1

PERT is a management tool that makes possible more accurate, more objective, and more rapid planning and control of a complex project. Applied research by the ONR-MC Task Analysis project staff indicated that a full description of PERT and its applications to Occupational Field (OF) studies would be of operational value to the Office of Manpower Utilization (OMU), HQ, USMC. This report on PERT is designed to serve two purposes. First, it can be used as training material for new personnel to introduce them to techniques of planning and control in OF studies. Second, it can provide ready reference materials for individuals directly involved in designing, directing, planning, and controlling OF studies. The description of PERT in this report is specifically addressed to Task Analysis as conducted by the Marine Corps. Accordingly, the various steps, events and activities used as illustrations in the application of PERT employ the terminology of the different phases of OMU's Task Analysis process. GRA

N77-11898# California State Univ., Los Angeles.
GUIDELINES FOR RESEARCH PLANNING AND DESIGN IN TASK ANALYSIS
William T. Farrell, C. Harold Stone, and Dale Yoder Sep. 1975 30 p refs Sponsored in part by the US Marine Corps, Washington, D. C.
(Contract N00014-74-A-0436-0001; NR Proj. 151-370; RR0420402)
(AD-A024132; TR-4) Avail: NTIS HC A03/MF A01 CSCL 05/1

The report focuses upon Task Analysis as research. It is based upon the the fact that the Task Analysis program conducted by the Office of Manpower Utilization, HQ, USMC (OMU) involves purposive, systematic investigations and analyses in order to prepare reports of findings that will be useful and influential in Marine Corps planning, policy determination, and management. Guidelines are presented for the planning and design of OMU's projects so that they will justify proper respect and credibility and thereby achieve maximum impact and value. Principles and procedures are outlined so that each Task Analysis project can be planned, designed and conducted in a manner consistent with recognized criteria of dependable scientific research. In addition to the focus upon the research nature of Task Analysis, the qualities of the researcher himself, and his influence upon the research are discussed. The main emphasis of the report is upon research planning and design. GRA

N77-11899# California State Univ., Los Angeles.
MANAGEMENT AUDITING
John M. Hemphill, Jr. and Dale Yoder Sep. 1975 28 p refs Sponsored in part by the US Marine Corps, Washington, D. C.
(Contract N00014-74-A-0436-0001; NR Proj. 151-370; RR0420402)
(AD-A024133; TR-5) Avail: NTIS HC A03/MF A01 CSCL 05/1

The Management Audit is described for possible application as an extension of the mission of the Office of Manpower Utilization (OMU), HQ, USMC. The present mission of OMU is viewed as a manpower research program to conduct Task Analysis of Marine Corps Occupational Fields. Purpose of the analyses is to improve the functional areas of classification, assignment, training, grade and MOS structure, job requirements, and job validation. Major topics in this report are purpose and scope of management auditing, overview of the management audit process, comparison of the management audit with task analysis, and implications of the management audit approach for OMU. Annotations of significant references on management auditing are included in a selected bibliography. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N77-11900 Pennsylvania Univ., Philadelphia.
THE EVALUATION OF INTEGRATED MARKET RESEARCH INFORMATION SYSTEMS FOR NEW PRODUCT DECISIONS Ph.D. Thesis
Lawrence Lapide 1976 181 p
Avail: Univ. Microfilms Order No. 76-22724

A methodology with which to evaluate the benefits that can be derived from using various combinations of market research data sources to aid new product decisions is presented. Multimeasurement systems consisting of retail outlet surveys and consumer panel surveys are emphasized. The new product innovation process and its informational requirements for decision making is discussed. Test marketing is identified as a key phase to focus upon because of the importance of retail outlets and consumer panel surveys in monitoring test market. Rollout commercialization is also identified as another key phase since it is essentially sequential test marketing. The advantages and disadvantages of various data sources for test marketing are discussed as well as the source of error in a test market and their relationship to its duration. Dissert. Abstr.

N77-11901*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VOCABULARY OF AEROSPACE SAFETY TERMS PERTAINING TO CRYOGENIC SAFETY, FIRES, EXPLOSIONS, AND STRUCTURE FAILURE
James J. Pelouch, Jr., George Mandel, and Paul M. Ordin Sep. 1976 122 p
(NASA-TM-X-73521; E-8935) Avail: NTIS HC A06/MF A01 CSCL 05B

This vocabulary listing characterizes the contents of over 10,000 documents of the NASA Aerospace Safety Research and Data Institute's (ASRDI) safety engineering collection. The ASRDI collection is now one of the series accessible on the NASA RECON data base. There are approximately 6,300 postable terms that describe literature in the areas of cryogenic fluid safety, specifically hydrogen, oxygen, liquified natural gas; fire and explosion technology; and the mechanics of structural failure.

To facilitate the proper selection of information nonpostable, related and array terms have been included in this listing.Author

N77-11902# Defense Documentation Center, Alexandria, Va.
INFORMATION SCIENCES: INFORMATION PROCESSING SYSTEMS AND TECHNIQUES Report Bibliography, Apr. 1958 - Nov. 1975
Apr. 1976 479 p Revised
(AD-A024600; DDC/BIB-76/02) Avail: NTIS HC A21/MF A01 CSCL 05/2

This bibliography is a compilation of citations on Information Sciences: Information Processing Systems and Techniques. This report includes references on information systems, testing techniques, user studies, surveys and requirements and machine translation. Four computer-generated indexes provided are Corporate Author-Monitoring Agency, Subject, Title and Personal Author. GRA

N77-11903# Moshman Associates, Inc., Bethesda, Md.
EVALUATION OF THE FEASIBILITY OF AN INDEPENDENT HSA DATA BASE RELATIVE TO PROPOSED HSA BUDGETS AND STAFFING Final Report, 10 Oct. 1975 - 10 Feb. 1976
10 Feb. 1976 149 p refs Sponsored by HEW
(PB-254920/2; BHPRD-76/2) Avail: NTIS HC A07/MF A01 CSCL 06E

The feasibility of centralization of HSA data bases, standards; criteria for determining when such centralization is indicated; and methods of estimating staffing and other costs were examined. The comparative advantages (economic, data availability, etc.) of each of the following alternatives were studied: (1) HSA-maintained data base, conservatively estimated at $40,000 - $50,000 annually, (b) centralization at state level or group level, i.e., states or HSAs. It is concluded that 'when appropriate conditions are met' centralization of a data base 'can most logically and naturally occur at the state level with primary attention to the type of the data that are available from state level sources.' GRA

N77-11904# Pennsylvania Univ., Philadelphia. Wharton School of Finance and Commerce.
DAISY: AN APPLICATIONS PERSPECTIVE Interim Report
Howard Lee Morgan Nov. 1975 42 p refs Presented at Joint Wharton/ONR Conf. on Interactive Inform. and Decision Support Systems, Penn. Univ., 7 Nov. 1975
(Contract N00014-75-C-0440; NR Proj. 049-360)
(AD-A023875; Rept-75-11-03) Avail: NTIS HC A03/MF A01 CSCL 09/2

DAISY is the acronym for Decision Aiding Information System, which is being developed by the author and his colleagues in the Department of Decision Sciences at the Wharton School for the Operational Decision Aiding Systems Project of the Office of Naval Research. It is meant to give tactical level decision makers the ability to integrate the latest in information systems, modeling and probabilistic estimation techniques into their own decision making activities. It is not meant to automate decisions, but rather to aid the decision maker (DM) as an intelligent staff officer might. This particular staff officer, however, provides the DM with access to distributed data bases, powerful mathematical modeling techniques, and a means of sequencing through the decision process, taking into account the 'wisdom of the ages', (i.e., the way in which previous decision makers have acted when confronted with similar situations). This paper attempts to describe the strategy and tactics employed in DAISY with emphasis on what the user sees, in line with the Applications Perspective of this talk. Command and control applications are specifically discussed as well as private sector applications. Additional specifics which may be of more interest to implementers have been included. Author (GRA)

N77-11905# Pennsylvania Univ., Philadelphia. Wharton School of Finance and Management.
DATA STORAGE DECISIONS FOR LARGE DATA BASES Ph.D. Thesis
Jay-Louise Weldon Feb. 1976 280 p refs
(Contract N00014-67-A-0216-0007; NR Proj. 049-272)
(AD-A023874; Rept-76-02-04) Avail: NTIS HC A13/MF A01 CSCL 09/2

This dissertation presents a systematic methodology for making configuration decisions for large data bases. For each phase of the methodology, informal and operational decision aids are provided. The primary design tool described is an interactive Data Base Configuration Model (DBCM). This model was developed to aid the data base designer in evaluating and comparing the cost and performance of alternative configurations. The methodology is illustrated by its applications to the configuration of a large data base: the 1970 Census of Population and Housing. GRA

N77-11906# National Bureau of Standards, Washington, D.C.
A TECHNOLOGICAL REVIEW: THE FUTURE OF MICRO-IMAGERY IN THE LIBRARY Final Report
Thomas C. Bagg Oct. 1975 11 p Repr. from Drexel Library Quart., v. 11, no. 4, Oct. 1975 p 66-74
(PB-255725/4; ISSN-0012-6160) Avail: NTIS HC A02/MF A01 CSCL 05B

Libraries use microforms in a variety of ways to save space, have available out-of-print materials, expand audiovisual materials. Despite the growing need of micrographic equipment, the libraries do not offer a large enough market to have equipment designed and produced for their specific needs. Libraries must therefore depend upon developments for other applications, some of which are discussed. GRA

N77-11907# Advisory Group for Aerospace Research and Development, Paris (France).
OCR AND ITS APPLICATION TO DOCUMENTATION: A STATE OF THE ART REVIEW
Donald A. Bush (RADC, New York) and J. A. Weaver (Mullard Res. Labs., Surrey, Engl.) Mar. 1976 37 p
(AGARD-AG-216; ISBN-92-835-1211-1) Avail: NTIS HC A03/MF A01

The problems of producing scientific and technical documentation are surveyed in terms of application of Optical Character Recognition (OCR) techniques. The function and method of operation of OCR machines are described in outline, and the limitations are discussed. Recommendations are given for improving documentation production, and areas for further research are suggested. Author

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N77-11908*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COST-BENEFIT ANALYSIS OF SPACE TECHNOLOGY
Gerald F. Hein, Steven M. Stevenson, and Joseph N. Sivo Washington Nov. 1976 26 p refs
(NASA-TM-X-3453; E-8796) Avail: NTIS HC A03/MF A01 CSCL 05C

A discussion of the implications and problems associated with the use of cost-benefit techniques is presented. Knowledge of these problems is useful in the structure of a decision making process. A methodology of cost-benefit analysis is presented for the evaluation of space technology. The use of the methodology is demonstrated with an evaluation of ion thrusters for north-south stationkeeping aboard geosynchronous communication satellites. A critique of the concept of consumers surplus for measuring benefits is also presented. Author

N77-11909# California Univ., Berkeley. Lawrence Berkeley Lab.
DYNAMIC PROGRAMMING APPROACH TO ESTIMATING GAPS IN LARGE ECONOMIC DATA BASES
F. M. Andres, H. Ruderman, and J. Sathaye Sep. 1975 20 p refs Presented at Operations Res. Soc. of Am. Conf., Las Vegas, Nev., 16 Nov. 1975
(Contract W-7405-eng-48)
(LBL-4271; Conf-751176-1) Avail: NTIS HC A02/MF A01

A suboptimal dynamic programming algorithm is proposed

to find a maximum likelihood estimator of the missing data items. (ERA)

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

N77-11910# Committee on Interstate and Foreign Commerce (U. S. House).
NOISE CONTROL ACT EXTENSION
Washington GPO 1975 105 p refs Hearings on H.R. 5272 before Subcomm. on Transportation and Commerce of Comm. on Interstate and Foreign Commerce, 94th Congr., 1st Sess., 24-25 Mar. 1975
(GPO-52-021) Avail: Subcomm. on Transportation and Commerce

The Noise Control Act of 1972, the assumptions behind its enactment, and its effects are examined in view of extending the Act for 27 months. J.M.S.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N77-11911 Pennsylvania Univ., Philadelphia.
TRADE-OFF ANALYSES FOR MULTI-OBJECTIVE TRANSPORTATION PLANS Ph.D. Thesis
Mehmet Oezdemir Akyilmaz 1976 314 p
Avail: Univ. Microfilms Order No. 76-22646

Trade-off analyses provide explicit presentation of the levels of achievement of various objectives by alternative transportation plans. This explicit presentation of the objective achievements is the core of information required for comparisons to be made among the alternatives. An evaluation method is developed to compare and evaluate the various types of trade-off analyses. This method which is cyclic in nature provides the characteristics (advantages and disadvantages) of trade-off analyses on which the comparison is based. Approaches are evaluated on the basis of a list of evaluation criteria. During this evaluation process, a new format is developed to present the generated trade-off information by the corridor planning model. Five types of trade-off approaches are investigated in this research. Various weighting schemes and constraint schemes are presented. To avoid difficulties in generating the information for one of the approaches, a strategy is recommended which will presumably lead to the selection of the best (best in terms of decision-maker's utility) alternative to be implemented. Dissert. Abstr.

N77-11912 California Univ., Berkeley.
THE CHOICE OF TECHNOLOGY IN TRANSPORT SYSTEM DEVELOPMENT Ph.D. Thesis
Mohammed Abdul-Aziz Alsheikh 1975 146 p
Avail: Univ. Microfilms Order No. 76-15094

A framework is developed that permits the explicit consideration of the network and its evolution in the assessment of the various transport technologies. In order to characterize the technology, the transport system is decomposed into its component parts. Then, the various transport technologies are viewed as processes that combine the vehicle and link inputs in varying proportions for the production of transport service. A precise definition of vehicle intensity is developed to permit the quantification of this attribute of the technology. To facilitate the comparison among the various transport technologies in this regard, the concept of vehicle intensity is considered explicitly in the formulation of a total cost function. The evolution of a simple network is modeled. The time development of the network is determined using the total discounted cost function as the objective function. A solution is obtained for a single case. Dissert. Abstr.

N77-11913 Cincinnati Univ., Ohio.
OPTIMAL PRODUCTIVITY FOR SOLID WASTE COLLECTION: A SYSTEMS APPROACH Ph.D. Thesis
Robert Maurice Clark 1976 104 p
Avail: Univ. Microfilms Order No. 76-21095

Analytic techniques or models were developed which provide normative measures of optimal solid waste collection productivity. The first model developed is the REM which can be used to rate each collection route based on physical and managerial variables as to its difficulty in terms of the weight which is collected from it, during a maximum work day. If the levels of the variables on the right side of the equation are fixed then the ratio of W sub d to W sub u gives the household units which a crew can serve per day on a given route. This ratio is the collection coefficient which is utilized in the ROM. The Route Optimization Model can be applied to achieve the minimum cost, set of crews, trucks, and routes to serve a given solid waste collection service area. Both models are fully transferable between systems and allow an objective comparison between the results achieved in one system versus results achieved in another. Dissert. Abstr.

N77-11914*# JWK International Co., Annandale, Va.
BENEFIT ASSESSMENT OF NASA SPACE TECHNOLOGY GOALS Final Report
26 Jul. 1976 128 p refs
(Contract NASw-2911)
(NASA-CR-149192) Avail: NTIS HC A07/MF A01 CSCL 05B

The socio-economic benefits to be derived from system applications of space technology goals developed by NASA were assessed. Specific studies include: electronic mail; personal telephone communications; weather and climate monitoring, prediction, and control; crop production forecasting and water availability; planetary engineering of the planet Venus; and planetary exploration. Author

N77-11915*# Stanford Univ., Palo Alto, Calif. Cardiology Div.
BIOMEDICAL TECHNOLOGY TRANSFER: APPLICATIONS OF NASA SCIENCE AND TECHNOLOGY Annual Report, Oct, 1975 - Sep. 1976
Sep. 1976 58 p refs
(Grant NGR-05-020-634)
Avail: NTIS HC A04/MF A01 CSCL 06B

The major efforts of the Stanford Biomedical Applications Team Program at the Stanford University School of Medicine for the period from October 1, 1975 to September 31, 1976 are covered. A completed EMG biotelemetry system which monitors the physiological signals of man and animals in space related research is discussed. The results of a pilot study involving lower body negative pressure testing in cardiac patients has been completed as well as the design and construction of a new leg negative pressure unit for evaluating heart patients. This technology utilizes vacuum chambers to stress the cardiovascular system during space flight. Laboratory tests of an intracranial pressure transducer, have been conducted. Extremely stable long term data using capacative pressure sensors has lead to the order of commercially manufactured monitoring systems base. Projects involving commercialization are: flexible medical electrodes, an echocardioscope, a miniature biotelemetry system, and an on-line ventricular contour detector. S.M.

N77-11916*# Rancho Los Amigos Hospital, Inc., Downey, Calif. Rehabilitation Engineering Center.
INVESTIGATION OF THE MEDICAL APPLICATIONS OF THE UNIQUE BIOCARBONS DEVELOPED BY NASA Final Report
Vert Mooney Oct. 1976 27 p refs Sponsored in part by the Veterans Admin. and NIH
(Contract NAS8-30631)
(NASA-CR-150061) Avail: NTIS HC A03/MF A01 CSCL 06B

Experience with 127 percutaneous implants in 43 patients

and volunteers is discussed. Pure carbon has demonstrated the highest level of success. It is indicated that prolonged success of these implants can be expected if mechanical factors are reduced to a minimum. Author

N77-11917# National Swedish Road and Traffic Research Inst., Stockholm.
FROST INSULATING MATERIALS IN ROADS
Rune Gandahl 1974 113 p refs In SWEDISH; ENGLISH summary
(VTI-40) Avail: NTIS HC A06/MF A01

A survey of the research and development work on frost insulating materials is presented. Different insulating materials such as bark, mineral wool, cellular plastics, and lightweight expanded clay were tested in situ for some years. Certain materials were shown to have good frost protective properties. The investigations are being continued and new materials and methods are continuously tested. Frost mechanics, frost damage, and frost insulating methods are treated from a practical point of view. Author (ESA)

N77-11918# National Swedish Road and Traffic Research Inst., Stockholm.
INFLUENCE OF SWEDISH BUILDING LIME ON THE PROPERTIES OF FINE GRAINED SOILS FOR ROAD CONSTRUCTION
Olli Waere 1974 94 p refs In SWEDISH; ENGLISH summary
(VTI-41) Avail: NTIS HC A05/MF A01

Comparative laboratory tests of four cohesive soils, with and without three different kinds of lime were performed. Apart from the usual tests for determination of the stability effect of the lime, fairly comprehensive freeze tests were performed in order to determine the frost heave tendency of lime-stabilized soils. According to the results, the stabilization effect showed only minor differences depending on the type of lime (siluric, chalky, orthoceratite). The frost susceptibility was found to increase for the clayey soils with increasing lime content, caused by the increased permeability. The silty fine sand on the other hand was found to be less frost susceptible by the lime stabilization. It was found necessary to perform full scale in situ tests for proper knowledge of the frost susceptibility of lime stabilized soils. Author (ESA)

N77-11919# National Swedish Road and Traffic Research Inst., Stockholm.
FACTORS CONTRIBUTING TO LOW FRICTION BETWEEN WHEELS AND ROAD SURFACE
Bengt Lilja and Evert Ohlsson 1974 22 p In SWEDISH; ENGLISH summary
(VTI-52) Avail: NTIS HC A02/MF A01

Results from various friction measurements were analyzed in order to try to identify factors which might cause low friction between tire and road surface. Surfacings with and without macro and microtexture are discussed. Effects on friction of vehicle speed, weather conditions, rutting, and sensitivity of the road structure to heat are described. Author (ESA)

N77-11920# National Swedish Road and Traffic Research Inst., Stockholm.
INFLUENCE OF MICA ON THE COMPACTION AND BEARING PROPERTIES OF BASE COURSE AGGREGATE
Peet Hoebeda and Lars Buensow 1974 58 p refs In SWEDISH; ENGLISH summary Sponsored by Swed. Road Admin.
(VTI-55) Avail: NTIS HC A04/MF A01

Compaction tests and bearing tests were carried out to determine the effect of mica in base course aggregate. Compaction tests were performed according to AASHO T-180. The extent of crushing by compaction is little affected by the mica content. Dry bulk densities obtained decrease considerably and almost linearly with increasing mica content. The mineral also counteracts the tendency for the formation of an optimum moisture content and the compaction curves are quite flat. Bearing tests were made according to the Swedish Earth Bearing Method at a load intensity of 5.0 kgf/sq cm. The values of the modulus decrease as the mica content increases, but are low even at slight degrees of water saturation, probably due to the resilience of the mineral. ESA

N77-11921# Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
OPTIMAL MANAGEMENT OF THE SUBSURFACE ENVIRONMENT: PARAMETER IDENTIFICATION
Robert Willis May 1976 71 p refs
(Contract DI-14-31-0001-5032)
(PB-255648/8; W76-10613; OWRT-A-052-NY(1)) Avail: NTIS HC A04/MF A01 CSCL 13B

Mathematical models are presented for assessing the potential impact of the artificial recharge of municipal wastewater effluents on the subsurface environment. A Galerkin finite element simulation model predicts the time and spatial variations of conservative and nonconservative constituent concentrations within the soil profile. The model incorporates time dependent nonequilibrium absorption and chemical and/or biochemical reactions. The model is used to estimate (1) the kinetic, dispersion, and adsorption parameters characterizing quality changes within the soil system, and (2) the initial distribution of a contaminant within the sorbed or solution phases at the inception of the spreading cycle. GRA

N77-11922# Massachusetts Inst. of Tech., Cambridge. School of Engineering.
ADVANCED DIAL-A-RIDE ALGORITHMS RESEARCH PROJECT Final Report, Apr. 1974 - Dec. 1975
Nigel H. M. Wilson, Richard W. Weissberg, and John Hauser Mar. 1976 130 p refs
(Grant UMTA-MA-11-0024)
(PB-254752/9; UMTA-MA-11-0024-76-1) Avail: NTIS HC A07/MF A01 CSCL 13B

Advanced dial-a-ride (ADAR) control procedures were developed and the problem of controlling integrated dial-a-ride/fixed route services was investigated. Background material (what a control algorithm does, who it serves, and various general elements of algorithms planning) is discussed along with work performed under the ADAR Project, and lessons learned from various demonstrations. GRA

N77-11923# Washington Univ., Seattle. Urban Transportation Program.
ASSESSING THE RELATIONSHIP BETWEEN URBAN FORM AND TRAVEL REQUIREMENTS: A LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK
James W. Clark Aug. 1975 47 p refs
(Contract FWPCA-WA-11-0003)
(PB-254988/9; UMTA-URT-3-75-6) Avail: NTIS HC A03/MF A01 CSCL 05K

The relationship between urban form and transportation energy consumption is studied. A thesis is that study of the relationship has been hampered by a lack of an operational definition for the concept of urban form. Addressing itself to this need, it is proposed that urban spatial structure be measured in terms of size, shape, and activity distribution of the urbanized area. The review of literature classifies previous studies according to the aspect of urban form which was investigated. Travel requirements appear to increase as urban area population increases, but beyond this finding, no clear relationship between urban form and total urban travel requirements has yet been established. GRA

N77-11924# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Urban and Regional Studies.
THE CENSUS AND TRANSPORTATION PLANNING: SURVEY OF EVALUATIONS AND RECOMMENDATIONS AS TO THE USEFULNESS OF THE 1970 CENSUS DATA IN URBAN TRANSPORTATION PLANNING Final Report
Robert C. Stuart and Michael R. Hauck Mar. 1976 53 p refs
(Contract UMTA-VA-11-0003)
(PB-254802/2) Avail: NTIS HC A04/MF A01 CSCL 05K

The usefulness of 1970 Census data for urban transportation planning with special emphasis placed on evaluating the 1970 Urban Transportation Planning Package was studied. The project seeks to: (1) Identify urban transportation planning-related data from the 1970 Census; (2) evaluate the uses of those data in urban transportation planning; (3) identify user problems; (4) identify alternative sources of these data products; and (5) develop a series of recommendations for the 1980 Census. Personal and telephone interviews with ten state, and twenty-five substate

regional agencies and three university and private consultants were used to generate the desired information. GRA

N77-11925# Transportation Research Board, Washington, D.C.
PLANNING AND PROGRAMMING FOR TRANSPORTATION
William T. Mikolowsky 1976 62 p refs
(PB-255637/1; TRB/TRR-574; ISBN-0-309-03488-9) Avail: NTIS HC A04/MF A01 CSCL 13B

The papers in this Record include: (1) an analysis of near-term transportation alternatives for the Los Angeles region; (2) a presentation of some of the long-range transportation planning alternatives for Saigon and some of the problems associated with applying the U.S. Department of Transportation planning packages in a remote location; (3) a description of a new interactive programming system for transportation planning; (4) a discussion of the development of a procedure for using the goal-programming technique to evaluate urban transit systems for meeting the transportation-related goals of a community; and (5) a discussion of how the linear-programming formulation is a valuable extension of current methods of cost-benefit analysis for highway improvements. GRA

N77-11926# RAND Corp., Washington, D.C.
A REVIEW OF CASE STUDIES OF TECHNOLOGICAL INNOVATIONS IN STATE AND LOCAL SERVICES Final Report
Robert K. Yin, Karen A. Heald, Mary E. Vogel, Patricia D. Fleischauer, and Bruce C. Vladeck Feb. 1976 331 p refs
(Grant NSF PRA-75-04134)
(PB-252914/7; R-1870-NSF; NSF/PRA-75-19-1) Avail: NTIS HC A15/MF A01 CSCL 05A

Case studies of technological innovations in local public services were collected and analyzed. Key factors associated with successful implementation were identified and suggest appropriate courses for Federal policies in stimulating future innovations. The case studies are examined by applying a structured set of questions to each case. Such a case survey method permits the aggregation of case study experiences in a reliable and rigorous manner. The topics to be covered by questions include technological, organizational, catalytic, and external factors. In this way, the case study experience can both be aggregated and analyzed to determine which of these factors, if any, appears to be most important. An executive summary is included. GRA

N77-11927# Army War Coll., Carlisle Barracks, Pa.
AN ANALYSIS OF THE TECHNOLOGY ROLE IN US POWER DURING THE MID-RANGE PERIOD Student Essay
Edward Miltner 21 Nov. 1975 31 p refs
(AD-A024042) Avail: NTIS HC A03/MF A01 CSCL 05/1

The role of technology predominates all elements of U.S. power. It is the key ingredient of defense planning; it looms as the bright spot in our balance of trade; it represents the heart of detente; it is responsible for the enormous improvement in our quality of life; and it is in the direction of technology that mankind seeks solutions in this new age of global interdependency and increased shortages of natural resources. The accelerating importance of technology to our nation's security and world leadership posture stands in astonishing contrast to the long and continuing decline of U.S. funding for research and development. A decline that poses a threat to our national defense - to our economic power - to the quality of life. Data was provided primarily from business and technology periodicals, federal budget review and texts pertaining to technology and its impact on the future. Federal support of R and D has dropped severely over the last decade to 1.2% of GNP. In view of the facts respecting the vital nature of technology to the nation and this reduced support of the R and D effort in the United States, it is recommended that all of the elements of U.S. power be reflected in the President's cabinet. The President's cabinet should be reorganized so that all five elements of U.S. power are represented, and in particular there be created a Secretary of Science and Technology and as a principal arm he creates a National Institute of Science and Technology. It is further suggested that national policy be established to provide five percent of gross national product for research and development. Author (GRA)

N77-11928# Clean Water Consultants, El Dorado, Calif.
TECHNICAL GUIDELINES FOR PUBLIC WATER SYSTEMS Final Report
Russell L. Culp Jun. 1976 474 p refs
(Contract EPA-68-01-2971)
(PB-255217/2) Avail: NTIS HC A20/MF A01 CSCL 13B

Technical guidelines for the design, operation, maintenance, staffing, and surveillance of public water systems including references and bibliography are presented. Topics discussed include: general design considerations, source development, treatment, chemical application, pumping facilities, storage, distribution systems, operation and maintenance, surveillance, and personnel. GRA

N77-11929# Pratt Inst., Brooklyn, N.Y.
URBAN DESIGN AND USAGE FACTORS OF PARATRANSIT VEHICLES AND FACILITIES Final Report
Ronald Adams and George Hildebrand Apr. 1976 150 p refs
(PB-255541/5; UMTA-NY-11-0011-76-1) Avail: NTIS HC A07/MF A01 CSCL 13B

Relevant technology development programs of equipment and facilities for para transit usage are discussed along with safety, human factors' and operators concerns, with special attention to boarding considerations of the elderly and handicapped. Local, line-haul and terminal facilities for paratransit vehicles are examined including ubiquitous treatments to support elderly/handicapped access, integration in high traffic, multi-modal terminal facilities; priority and exclusive rights-of-way with the long-term prospect of wayside power to overcome limitations of chemical battery storage; and introduction of electric powered vehicles. GRA

N77-11930# Urban Mass Transportation Administration, Washington, D.C. Office of Research, Development and Demonstration.
FUTURE SCENARIOS FOR URBAN TRANSPORTATION Final Report
Michael Patrick Leahy Aug. 1975 120 p refs
(PB-255349/3; UMTA-RDD-9-75-1) Avail: NTIS HC A06/MF A01 CSCL 13B

Using total energy consumption comparisons, the internal combustion auto that meets DOT suggested fuel economy standards for 1980 (19.6 mpg) is twice as energy intensive as the diesel bus, three times as energy intensive as rapid rail and the electric bus, and five times as energy intensive as the electric car and the advanced GRT. It is concluded that to decrease energy consumption, improve urban air quality, and improve urban transportation, strategies should be aimed at achieving a transit and electric intensive modal split. Opportunities for action include (1) strongly supporting HR 8800, which, if passed, will appropriate $160 million for 5 years to the Energy Research and Development Administration (ERDA) for Electric Vehicle R and D; (2) working in cooperation with ERDA to develop an urban private passenger electric vehicle and improved battery powered electric bus. GRA

N77-11931# Urban Inst., Washington, D.C.
THE CONSEQUENCES OF TRANSIT FARE AND SERVICE POLICIES: A CLASSIFIED BIBLIOGRAPHY
Michael A. Kemp and Rebecca L. Rea Apr. 1976 40 p refs
Sponsored by Urban Mass Transportation Administration
(PB-253101/0; UMTA-DC-06-0120-76-3;
Working-Paper-5050-1-2) Avail: NTIS HC A03/MF A01 CSCL 13B

The bibliography is concerned with the consequences---most specifically the ridership and cost implications--of various policies regarding service and fare levels for urban public transit. Cited publications are classified under separate headings for ease in reference. These are: the demand for transit service, fare and service elasticities of demand; transit operating costs; the economics of transit pricing; public subsidies for transit operations; low-fare and no-fare transit; transit fare structures; transit fare and the distribution of income; transit and the transportation disadvantaged; transit planning, operation and evaluation; marketing transit; and general reference material. (GRA)

N77-11932# Tennessee Univ., Knoxville. Dept. of Civil Engineering.
TRANSPORTATION PLANNING FOR SMALL URBAN

AREAS Final Report
W. L. Grecco, F. J. Wegmann, J. A. Spencer, and A. Chatterjee Jun. 1976 85 p refs Sponsored by the Am. Assoc. of State Highway and Transportation Officials, Washington, D.C. and the Federal Highway Admin.
(PB-256119/9; ISBN-0-309-0250-0; TRB/NCHRP/REP-167) Avail: NTIS HC A05/MF A01 CSCL 13B

The focus of the research was to develop a simplified transportation planning process for small urban areas of less than 250,000 population, primarily focussing on travel simulation techniques based on a small sample travel surveys. The research identified and presented four types of transportation planning techniques for application in small urban areas: (a) network simulation based on synthetic models and a small sample household survey, (b) consumer-orlented transit planning procedure, (c) simple techniques for corridor analysis and (d) hand-computation oriented procedure for estimating localized impacts of major traffic generators. (GRA)

N77-11933# Qei, Inc., Bedford, Mass.
ECONOMIC WELFARE IMPACTS OF URBAN NOISE Final Report
Rodney Thorpe and Thomas Holmes May 1976 216 p refs (Contract EPA-68-01-2634)
(PB-256411/0; EPA-600/5-76-002) Avail: NTIS HC A01/MF A01 CSCL 13B

The basic purpose of this project was to develop a conceptual framework for estimating the social welfare gains or benefits of reducing current noise levels in urban environments. The project has concentrated on developing economic welfare theory and empirical techniques to assess willingness-to-pay by individuals for noise avoidance. Particular attention was paid to noise produced by motor vehicles and noise produced by operations at construction sites. The theoretical effect of the localized nature of noise on people's willingness-to-pay to control noise was investigated. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N77-11934 Rice Univ., Houston, Tex.
ESCAPE OF CHARGED PARTICLES FROM A NEUTRON STAR Ph.D. Thesis
Michael Alexander Pelizzari 1976 86 p
Avail: Univ. Microfilms Order No. 76-21704

The theory of particle trajectories in an axisymmetric magnetic field, was extended to cover conservative force fields. The escape of charged particles from a rapidly rotating neutron star, enabling one to determine the maximum range of their trajectories in space was studied. It is shown that a neutron star, rotating in a vacuum with rotation and magnetic axes aligned, will not evolve a perfectly conducting magnetosphere if the neutron star is the only source of charge. The sign of charge accelerated from the equatorial regions is magnetically trapped to a toroidal region very near the star, and the opposite sign of charge, emerging from the polar regions, escapes from the magnetosphere until a critical stellar charge is reached, after which polar charges are electrostatically bound to the magnetosphere. Dissert. Abstr.

N77-11935*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPECTRA OF Her X-1 NEAR A TURN-ON IN THE 35-DAY CYCLE
R. H. Becker, E. A. Boldt, S. S. Holt, S. H. Pravdo, R. E. Rothschild, P. J. Serlemitsos, B. W. Smith, and J. H. Swank Oct. 1976 18 p refs Submitted for publication
(Grant NGR-21-002-316)
(NASA-TM-X-71213; X-661-76-217) Avail: NTIS HC A02/MF A01 CSCL 03A

X-ray spectra for Her X-I are presented for times before, during, and after a turn-on in the 35 day on-off cycle, as well as during an anomalous dip in the X-ray intensity. All four spectra are well represented by a power law of number index approximately .9 with a high energy cutoff near 20 keV. However, the column density of cold matter along the line of sight as estimated by the low energy cutoff varies substantially among the four intervals. The low level flux present prior to turn-on does not pulse and shows very little low energy absorption, in contrast to the X-rays observed during the turn-on and the anomalous dip. It seems likely that the pre-turn-on flux is composed of X-rays scattered into the line of sight by material away from the accretion disk. Author

N77-11936*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PHOTOMETRIC STUDY OF THE ORION OB 1 ASSOCIATION. 2: PHOTOMETRIC ANALYSIS
Wayne H. Warren, Jr. and James E. Hesser (Cerro Tololo Inter-American Observatory, La Serena, Chile) Oct. 1976 87 p refs Submitted for publication
(NASA-TM-X-71217; X-671-76-237) Avail: NTIS HC A05/MF A01 CSCL 03A

The procedures adopted for analysis of photometric data in terms of color excesses, intrinsic color indexes, absolute visual magnitudes, and rotational-velocity effects are discussed in detail for Orion association B-, intermediate (I)-, and AF-type stars. The effects of the nebular environment and a comparison of various calibrations of Balmer-line and four-color indexes are considered for the determination of individual absolute magnitudes for B-type stars. When absolute magnitudes of stars in the region of the Orion Nebula are determined from the beta index, emission mechanisms appear to spuriously brighten them. A detailed comparison of absolute magnitudes derived from Balmer-line indexes and MK spectral-type calibrations is presented. The data are also examined with regard to the effects of polarization and infrared excesses. The results suggest a complex combination of intracluster and circumstellar origins for these processes. Author

N77-11937*# Linguistic Systems, Inc., Cambridge, Mass.
OCCURENCE OF GAS HYDRATES IN THE NUCLEII OF COMETS
A. H. Delsemme Washington NASA Jul. 1976 20 p refs Transl. into ENGLISH from Mem. Soc. Roy. Sci. Liege (Belgium), v. 12, no. 1, 1966 p 69-76, 112-115
(Contract NASw-2482)
(NASA-TT-F-16740) Avail: NTIS HC A02/MF A01 CSCL 03C

Quantitative considerations show that OH productions provided by observations on cometary heads are compatible with H2O sublimation rates of water ice or hydrate ices present within the nucleus. As the presence of H2O molecule within the nucleus is thus confirmed by circumstantial considerations, thermodynamic evidence leaves little alternate possiblity to the presence of clathrate CH4 hydrate. The molecular fragments observed spectrally on cometary heads come from different chemical species which have the particular effect of bunching together the orders of magnitude of all the sublimation rates. This is the reason why it is considered that most volatile molecules could be enclosed in hydrates. Author

N77-11938# Air Force Geophysics Lab., Hanscom AFB, Mass. Terrestrial Sciences Div.
STAR CATALOGUES AND THEIR SIGNIFICANCE TO GEODESY OF THE 1980'S
M. S. Hunt Feb. 1976 27 p refs
(AF Proj. 7600)
(AD-A024156; AFGL-TR-76-0015; AFGL-AFSG-338) Avail: NTIS HC A03/MF A01 CSCL 08/5

Star catalogues are important tools for the geodesist in the determination of astronomic position and azimuth. Fundamental general catalogues contain the most accurate stellar positions and proper motions. Like other users, the geodesist depends on

astrometrists for the discussion and development of fundamental general catalogues. The internationally accepted FK4 is the best contemporary fundamental general catalogue. An expanded and improved revision, the FK5, is planned for completion by 1980. Because of increasing accuracy requirements for astronomic position and azimuth, it is desirable that the geodesist be aware of uncertainties contained within catalogues. The general development of star catalogues is included as background information. Author (GRA)

N77-11939# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space. Research.
OBSERVATIONS OF JUPITER WITH A HADAMARD TRANSFORM SPECTROMETER Final Report, 15 Jan. 1974 - 14 Jan. 1976
Martin Harwit Apr. 1976 60 p refs
(Contract F19628-74-C-0110; AF Proj. 8603)
(AD-A025273; AFGL-TR-76-0072) Avail: NTIS HC A04/MF A01 CSCL 03/2

During the past two years, Cornell University has prepared for observations of Jupiter to determine spectral differences at different latitudes. A Hadamard transform spectrometer was modified to make it capable of simultaneously observing regions at 15 different latitudes, at a spectral resolving power of 1/cm. Some 255 different spectral elements are simultaneously observed so that a spectral coverage approximately 2 micrometers is obtained for a single grating setting. It was initially proposed to obtain spectra across the entire 8 micrometer to 13 micrometer region, using this instrument. General advances in data reduction, in error analysis, and in atmospheric studies have been made. Three papers that appear as appendices to this report described much of the work accomplished in these domains. GRA

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N77-11940 California Inst. of Tech., Pasadena.
ACCRETION INTO AND EMISSION FROM BLACK HOLES Ph.D. Thesis
Don Nelson Page 1976 140 p
Avail: Univ. Microfilms Order No. 76-23114

Matter may fall into a black hole in a galactic nucleous or in a binary system and matter may be created and come out of the gravitational field of a black hole in a quantum-mechanical process. The conservation laws of rest mass, energy, and angular momentum are used to calculate the radial structure of an accretion disk flowing into the hole. The torque in the disk and flux of radiation from the disk are expressed as explicit, algebraic functions of radius. The emission rates of massless particles are computed numerically. The resulting power spectra of neutrinos, photons, and gravitons emitted by a nonrotating hole are given. For rotating holes, the rates of emission of energy and angular momentum are calculated for various values of the rotation parameter. It is found that angular momentum is lost considerably faster than energy, so that a black hole spins down to a nearly nonrotating configuration before it loses a large fraction of its mass. The implications are discussed for the lifetimes and possible present configurations of primordial black holes. Dissert. Abstr.

N77-11941 California Inst. of Tech., Pasadena.
INTERSTELLAR SPACE: THE ASTROCHEMIST'S LABORATORY Ph.D. Thesis
Mark Andrew Allen 1976 270 p
Avail: Univ. Microfilms Order No. 76-23379

A mechanism for the formation of molecules on small interstellar grains is proposed. The energy liberated when a chemical bond is formed between two atoms on a grain is transferred to the lattice vibrations of the grain, heating up the grain. The hot grain, during the time that it is radiatively recooling, may then libe its adsorbed volatiles. The timescales for molecular desorpti from a grain are calculated for OH and CO for four different grain compositions. A simplified H2 formation model is presented that utilizes this surface reaction mechanism. The nascent H2 molecules are ejected in excited states in qualitative agreement with Copernicus observations. With the synthesis of H2 as the dominant process, a time-dependent treatment of the chemical evolution of a dark cloud with little or no ionizing radiation shows that the clouds require more than 10 to the 7th power years to achieve chemical equilibrium. Dissert. Abstr.

N77-11942 Indiana Univ., Bloomington.
A STUDY OF THE 6180 ANGSTROM DIFFUSE INTERSTELLAR BAND Ph.D. Thesis
William Lee Stein 1976 146 p
Avail: Univ. Microfilms Order No. 76-21606

The strength of the 6180A band was determined for over 240 early type stars by means of a photoelectric photometer utilizing two narrow band interference filters. A 6180A index was established by a using a procedure analogous to what Crawford used for his H beta index. In addition, for twelve stars, satellites were examined with a silicon intensifier target (SIT) vidicon spectrometer system. Instrumental effects were eliminated by taking the ratio of the profile of the program star with the profile of its comparison star, an unreddened star of similar spectral type. Dissert. Abstr.

N77-11943 Princeton Univ., N.J.
STUDIES OF GALACTIC STRUCTURE: THE FORMATION OF GALACTIC NUCLEI, THE EVOLUTION OF SATELLITE GALAXIES, AND THE STABILITY OF BARS Ph.D. Thesis
Scott Duncan Tremaine 1975 93 p
Avail: Univ. Microfilms Order No. 76-22609

It is shown that globular clusters passing near the center of a galaxy interact with the background stars through dynamical friction and spiral to the galactic center, where they may form a compact central structure. It is suggested that these structures should be identified with observed galactic nuclei, and this proposal is tested against observations of the nuclei of M31, the Galaxy, nearby elliptical galaxies, and galaxies with active nuclei. It is shown if the Galaxy has a rotation curve which is flat to at least 30 kpc, then dynamical friction will cause substantial decay of the orbits of the Magellanic Clouds within the age of the Universe. This process of accretion of satellite galaxies may be a source of noticeable luminosity evolution in many giant galaxies. Finally, the stability of a family of elliptical stellar disks is examined. Their stability to first and second-harmonic coplanar modes is calculated, and qualitative estimates of their stability to other normal modes are made. Dissert. Abstr.

N77-11944*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONS AT THE PLANET MERCURY BY THE PLASMA ELECTRON EXPERIMENT, MARINER 10
K. W. Ogilvie, J. D. Scudder, V. M. Vasyliunas (Max-Planck-Inst. fuer Aeronomie), R. E. Hartle, and G. L. Siscoe (California Univ., Los Angeles) Sep. 1976 64 p refs Submitted for publication
(NASA-TM-X-71210; X-692-76-223) Avail: NTIS HC A04/MF A01 CSCL 03C

Plasma electron observations made onboard Mariner 10 are reported. Three encounters with the planet Mercury show that the planet interacts with the solar wind to form a bow shock and a permanent magnetosphere. The observations provide a determination of the dimensions and properties of the magnetosphere, independently of and in general agreement with magnetometer observations. The magnetosphere of Mercury appears to be similar in shape to that of the Earth but much smaller in relation to the size of the planet. Electron populations similar to those found in the Earth's magnetotail, within the plasma sheet and adjacent regions, were observed at Mercury; both their spatial location and the electron energy spectra within them bear qualitative and quantitative resemblance to corresponding observations at the Earth. The magnetosphere of Mercury resembles to a marked degree a reduced version of that of the Earth, with no significant differences of structure. Author

N77-11945*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPARISON OF THE COMPOSITION OF NEW AND EVOLVED COMETS

Bertram Donn Oct. 1976 22 p refs Submitted for publication
(NASA-TM-X-71215; X-690-76-230) Avail: NTIS HC A02/MF A01 CSCL 03C

The intensity ratio of the continuum to the molecular emissions was estimated in the spectra of eight-five comets. Four conclusions are drawn: (1) There is no readily apparent difference in continuum to emission intensity ratio between new and more evolved comets; (2) an intrinsic distribution of this characteristic does occur; (3) periodic comets with weak continua are derived from new comets with the same property; and (4) no weakening of the continuum in general occurs following perihelion passage. The infrared evidence for comet Encke suggests that the faintness of its continuum may be caused by a size distribution containing only particles larger than about 10 um. Author

N77-11946*# Transemantics, Inc., Washington, D.C.
NEUTRINO ASTROPHYSICS
V. S. Berezinskiy and G. T. Zatsepin NASA Oct. 1976 87 p Transl. into ENGLISH of the mono. "Neytrinnaya Astrofizika (Novoye v Zhizni, Nauke, Tekhnike. Seriya Kosmonavtika, Astronomiya no. 4)" Moscow, Znaniye Press, 1975 p 1-64 (Contract NASw-2792)
(NASA-TT-F-17249) Avail: NTIS HC A05/MF A01 CSCL 03B

A description of the contemporary state of neutrino astrophysics, the science of neutrino emission of stars and of the universe, the role of the neutrino in their evolution is given. New properties of the neutrino that can be identified from astrophysical observations are examined. Particular attention is paid to the problem of solar neutrinos. Author

N77-11947*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIO OBSERVATIONS OF INTERPLANETARY MAGNETIC FIELD STRUCTURES OUT OF THE ECLIPTIC
R. J. Fitzenreiter, J. Fainberg, R. R. Weber, H. Alvarez (Michigan Univ., Ann Arbor), F. T. Haddock (Michigan Univ., Ann Arbor), and W. H. Potter (Michigan Univ., Ann Arbor) Nov. 1976 16 p refs Submitted for publication
(NASA-TM-X-71223; X-692-76-244) Avail: NTIS HC A02/MF A01 CSCL 03B

New observations of the out-of-the ecliptic trajectories of type 3 solar radio bursts have been obtained from simultaneous direction finding measurements on two independent satellite experiments, IMP-6 with spin plane in the ecliptic, and RAE-2 with spin plane normal to the ecliptic. Burst exciter trajectories were observed which originated at the active region and then crossed the ecliptic plane at about 0.8 AU. A considerable large scale north-south component of the interplanetary magnetic field is followed by the exciters. The apparent north-south and east-west angular source sizes observed by the two spacecraft are approximately equal, and range from 25 deg at 600 KHz to 110 deg at 80 KHz. Author

N77-11948*# Stanford Univ., Calif. Inst. for Plasma Research.
INTERPLANETARY SECTOR STRUCTURE 1947 - 1975
Leif Svalgaard Feb. 1976 81 p refs
(Grants NGR-05-020-559; NSF ATM-74-19007; Contract N00014-76-C-0207)
(NASA-CR-149175; AD-A024602; SU-IPR-648) Avail: NTIS HC A05/MF A01 CSCL 03/2

This report is an extension of 'An Atlas of Interplanetary Sector Structure 1957-1974' to include earlier years back to 1947 and also the years 1932-1933 and 1975. GRA

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N77-11949 Rice Univ., Houston, Tex.
THE LUNAR EXOSPHERE Ph.D. Thesis
John Louis Benson 1976 201 p
Avail: Univ. Microfilms Order No. 76-21664

Lunar exospheric ions are accelerated by the solar wind electric field into the Suprathermal Ion Detector Experiment (SIDE) which was deployed on the lunar surface during the Apollo missions. Analysis of simultaneous mass and energy spectra from the SIDE indicates that the dominant component of the exosphere at the lunar surface is neon. The energy spectra of the ions indicate that neutral neon follows an exponential height distribution in the lunar terminator regions with a surface concentration of approximately 100,000/cu cm. The solar wind electric field removes neon from the lunar exosphere at the rate of .25 gm/sec. This is consistent with the assumption that the solar wind is the only source of lunar exospheric neon. The ion spectra observed in the terminator regions also indicate that a surface potential on the order of -50 V exists when these spectra are observed. The effective screening length of this potential is of the order of 1 km. Dissert. Abstr.

N77-11950 Rice Univ., Houston, Tex.
THE APOLLO 17 INFRARED SCANNING RADIOMETER Ph.D. Thesis
Wendell Willkie Mendell 1976 186 p
Avail: Univ. Microfilms Order No. 76-21695

The infrared scanning radiometer was designed to map the thermal emission of the lunar surface from the Service Module of the orbiting Apollo 17 spacecraft. The principle experimental objective was the measurement of lunar surface nighttime temperatures, which are extremely difficult to map from Earth-based telescopes. Lunar regions are classed according to surface properties as determined by nighttime temperatures and cooling rates. Geophysical boundaries are established from thermal maps of the highest possible spatial resolution. Preliminary studies of the data reveal the highest population of thermal anomalies in Oceanus Procellarum. Dissert. Abstr.

N77-11951*# Transemantics, Inc., Washington, D.C.
MODELING DYNAMIC PROCESSES IN PLANETARY ATMOSPHERES. PART 1: APPARATUS FOR STUDYING SHEAR FLOW STABILITY IN SPHERICAL LAYERS, PRELIMINARY RESULTS
G. I. Petrov NASA Oct. 1976 35 p refs Transl. into ENGLISH of "Modelirovaniye Dinamicheskikh Protsessov v Atmosferakh Planet. Ch. 1: Ustanovka dlya Izucheniya Ustochivosti Sdvigovykh Techeniy v Sfericheskikh Sloyakh. Predvaritelnyye Rezultaty" Rept. Pr-255, Inst. of Space Res., Acad. Sci. USSR, Moscow, 1975 p 1-38
(Contract NASw-2792)
(NASA-TT-F-17262; PR-255) Avail: NTIS HC A03/MF A01 CSCL 03B

The stability of shear flows of liquid and gas in rotating spherical layers is of interest for numerous astrophysical and geophysical problems concerning planetary and stellar atmospheres. In the first instance this pertains to large-scale global motions when curvature cannot be ignored. When studying this type of motion one must take into consideration the various physical processes occurring in the environment, the stratification of the environment, external conditions, etc. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N77-11952 Colorado Univ., Boulder.
NONRELATIVISTIC ELECTRON STREAM PROPAGATION IN THE SOLAR ATMOSPHERE AND SOLAR WIND: TYPE 3 BURSTS Ph.D. Thesis
Glenn Ronald Magelssen 1976 197 p
Avail: Univ. Microfilms Order No. 76-23649

Electron streams with type III burst characteristics are numerically modeled. The electron stream distribution is assumed to be one-dimensional in spatial and velocity space and the corresponding excited plasma wave spectrum is assumed to be

one-dimensional in spatial and phase velocity space. The quasilinear equations with the addition of spontaneous emission, magnetic, and collisional effects are numerically solved as an initial value problem with time, space, and velocity as the independent variables for a solar-type background plasma and a type-III-like stream. Background density and temperature spatial structure, spontaneous emission, magnetic fields, electron-ion collisions, stream wave reabsorption, and wave pileup are shown to affect stream propagation and are incorporated into a physical description of this propagation. Dissert. Abstr.

N77-11953 Rice Univ., Houston, Tex.
SOLAR WIND INDUCED CURRENTS IN THE ATMOSPHERES OF NON-MAGNETIC PLANETS Ph.D. Thesis
Robert Edward Daniell, Jr. 1976 100 p
Avail: Univ. Microfilms Order No. 76-21670

The electric current distribution in a conductor characterized by a scalar conductivity may be derived by minimizing the Joule heating subject to the condition that the current be divergenceless. This variational principle is generalized to include conductors characterized by tensor conductivities. Physically correct equations are derived only if the current density, j, and the electric field, E, are treated as independent quantities connected only through the boundary conditions. The divergenceless current constraint is eliminated by expressing the Joule heat in terms of two potentials--one defined in terms of j and the other, in terms of E. This variational principle is applied to a two dimensional model of a nonmagnetic planet whose atmosphere interacts directly with the solar wind. The magnetized solar wind induces a dynamo electric field which derives currents in the ionosphere. The resulting solution provides information concerning mass addition by the solar wind as well as determining the current density and electric field in the ionosphere. Dissert. Abstr.

N77-11954*# Joint Publications Research Service, Arlington, Va.
NUCLEAR REACTIONS ON THE SUN
G. Ye. Kocharov Washington NASA Oct. 1976 46 p Transl. into ENGLISH of the Mono. "Yadernyye Reaktsii na Solntse (Novoye v Zhizni, Nauke, Tekanike. Seriya Kosmonavtika, Astronomiya)" Moscow, Znaniye Press, 1976 p 1-64
(NASA Order W-13183)
(NASA-TT-F-17267) Avail: NTIS HC A03/MF A01 CSCL 03C

Theories, hypotheses, and the results of experiments concerned with efforts to identify the mechanisms of solar nuclear reactions and explain them, are discussed. Current hypotheses are critically evaluated and current planning and implementation of further experiments are described. Author

N77-11955*# Stanford Univ., Calif. Inst. for Plasma Research.
THE HALE SOLAR SECTOR BOUNDARY
Leif Svalgaard and John M. Wilcox Mar. 1976 20 p refs
(Grants NGR-05-020-559; NSF ATM-74-19007; NSF DES-75-15664; Contract N00014-76-C-0207)
(NASA-CR-149173; AD-A024605; SU-IPR-661) Avail: NTIS HC A02/MF A01 CSCL 03/2

A Hale solar sector boundary is defined as the half (Northern Hemisphere or Southern Hemisphere) of a sector boundary in which the change of sector magnetic field polarity is the same as the change of polarity from a preceding spot to a following spot. Above a Hale sector boundary the green corona has maximum brightness, while above a non-Hale boundary the green corona has a minimum brightness. The Hale portion of a photospheric sector boundary tends to have maximum magnetic field strength, while the non-Hale portion has minimum field strength. GRA

N77-11956*# Stanford Univ., Calif.
THREE-DIMENSIONAL STRUCTURE OF THE EXTENDED SOLAR MAGNETIC FIELD AND THE SUNSPOT CYCLE VARIATION IN COSMIC RAY INTENSITY
Leif Svalgaard and John M. Wilcox Mar. 1976 16 p refs
(Grants NGR-05-020-559; NSF ATM-74-19007; NSF DES-75-15664; Contract N00014-76-C-0207)
(NASA-CR-149174; AD-A024604; SU-IPR-662) Avail: NTIS HC A02/MF A01 CSCL 03/2

A principal cause for the eleven-year sunspot cycle variation in the primary cosmic ray intensity observed at earth may be a variation in the solid angle of the heliosphere occupied by the extended solar polar magnetic field. Galactic cosmic rays have relatively easy access to the inner solar system through the regular extended solar polar fields, and relatively difficult access through the irregular extended solar sector structure fields. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N77-11957 Colorado Univ., Boulder.
RADIATIVE TRANSFER AND GAS DYNAMICS IN GALACTIC X-RAY SOURCES Ph.D. Thesis
Stephen Pinckney Hatchett, II 1976 134 p
Avail: NTIS Avail: Univ. Microfilms Order No. 76-23622

Galactic X-ray sources, particularly binary sources, are investigated by studying the transfer of radiation from a point source of X-rays through a given gas distribution and by considering how the radiation affects the gas flow. The simple case of radiative transfer through a constant density gas is investigated first. A scaling law for optically thick cases is derived. The temperature and ionization structure are sensitive to the X-ray source spectrum, particularly to the relative luminosity in soft X-rays. The emerging spectrum is rich in optical, UV, and X-ray emission lines. Investigations of the radiative transfer from an X-ray source through a stellar wind from a companion star show observable geometric effects that can be used to derive some parameters of X-ray binary systems and to set constraints on others. Dissert. Abstr.

N77-11958 Johns Hopkins Univ., Baltimore, Md.
LINEAR POLARIZATION MEASUREMENTS ON GAMMA RAYS FROM Pd-100, Pd-102, Pd-104 AND Pd-106 Ph.D. Thesis
David Charles Stromswold 1976 134 p
Avail: Univ. Microfilms Order No. 76-22955

Linear polarizations of gamma rays from Pd-100, Pd-102, Pd-104, and Pd-106 following (Heavy ion, xn) reactions were measured using a Ge(Li) Compton polarimeter. Analysis of these polarizations together with previous angular distribution measurements and gamma-gamma correlations has provided parity assignments for many high-spin states in the four neutron deficient nuclides. In each nuclide two prominent negative parity sidebands were identified. Gamma ray multipolarities and mixing ratios are tabulated and energy level diagrams are presented. A quasirotational model of the nucleus is employed to interpret the observed structure including the negative parity sidebands and the onset of backbending in Pd-104 and Pd-106. An alternate model, the Interacting Boson Approximation, is also applied to the four nuclides and found most suitable for Pd-100. Dissert. Abstr.

N77-11959 Rice Univ., Houston, Tex.
MEASUREMENT OF THE LOW-ENERGY GAMMA RADIATION FROM THE GALACTIC CENTER REGION Ph.D. Thesis
George David Walraven 1976 155 p
Avail: Univ. Microfilms Order No. 76-21718

A balloon-borne gamma ray telescope observed the galactic center region in the 0.02 MeV - 12.27 MeV energy interval. The gamma ray spectrum was found to be characterized by a power law continuum with superimposed spectral features that were identified as gamma ray nuclear lines. Probable sources for these lines are the relatively abundant nuclides Ne-20, Mg-24, and Si-28. At 4.6 + or - 0.1 MeV a spectral feature consistent with a 10% broadened line was detected. The 4.43 MeV line of C-12 was taken to be the most probable source. The results of the present experiment thus constitute the first detection of extra-solar system gamma ray nuclear lines. The general mechanism responsible for the production of the gamma ray

nuclear lines was taken to be the interaction of low energy cosmic rays with the interstellar medium. From an analysis of the relative intensities of the various lines, an estimate for the power law index of the low energy cosmic ray spectrum in the galactic center region was obtained. Dissert. Abstr.

N77-11960 Texas Univ., Dallas.
DETERMINATION OF COSMIC RAY MUON INTENSITIES DEEP UNDERGROUND Ph.D. Thesis
Yashvant Keshavlal Jani 1976 216 p
Avail: Univ. Microfilms Order No. 76-23151

The cosmic ray muon component was measured by the Penn-Texas collaboration in two underground Cerenkov counter experiments at the Barberton Limestone Mine and at the Homestake Gold Mine. The vertical muon intensity is evaluated at Barberton from the coincidence rates of the vertical and inclined counter telescopes, as well as from the counting rates of the omnidirectional single counters. The vertical muon intensity at Homestake is evaluated from the omnidirectional single counter counting rates. In order to determine the precise value of the geometrical factor of the coincidence telescopes and single counters, a numerical method is developed using the complex angular distribution of muons deep underground. Both the Barberton and Homestake results the depth-intensity relation of cosmic ray muons. Dissert. Abstr.

N77-11961 Rice Univ., Houston, Tex.
OBSERVATIONS OF PLASMA IN THE GEOMAGNETIC TAIL AT LUNAR DISTANCES Ph.D. Thesis
David Alfred Hardy 1976 241 p
Avail: Univ. Microfilms Order No. 76-21680

Using data obtained from the three suprathermal ion detector experiments stationed on the lunar surface, it was determined that there exist two distinct and extensive plasma regimes within the geomagnetic tail at the distance of the moon's orbit. The first of these regimes is the plasma sheet. Data indicate that the plasma sheet extends to the distance of the lunar orbit with approximately the same spatial extent as observed closer to the earth. In the ions the plasma sheet is found to be much colder than at distances closer to the earth. Dissert. Abstr.

N77-11962 Arizona Univ., Tucson.
THE MASS SPECTRUM OF CHARGED COSMIC RAYS AT MOUNTAIN ALTITUDES Ph.D. Thesis
Herbert Bradford Barber 1976 159 p
Avail: Univ. Microfilms Order No. 76-22478

A cosmic ray mass spectrometer using a superconducting magnet, digitized wire spark chambers, and a scintillation counter time of flight system has been operated at an altitude of 2750 meters. The apparatus is most sensitive to charge particles with momentum to mass ratios between 0.2 and 2.0. Operation of the apparatus is analyzed. Results for the momentum spectra of protons, deuterons, He-4 and muons are presented and upper limits are obtained for antiprotons, charged k-mesons, H-3, He-3, hypothetical superdense nuclei, and hypothetical massive particles in the 5 to 10 GeV/sq cm c squared mass range. Results are discussed and interpreted in terms of a cosmic ray atmospheric cascade calculation developed for that purpose. Dissert. Abstr.

N77-11963 California Univ., San Diego.
OBSERVATION OF THE GALACTIC HARD X-RAY BACKGROUND FROM THE OSO-7 SATELLITE Ph.D. Thesis
William Ashley Wheaton 1976 190 p
Avail: Univ. Microfilms Order No. 76-22022

The hard X-ray background of the Galaxy was investigated using data from the UCSD cosmic X-ray telescope on the OSO-7 satellite. The results are relevant to a variety of emission mechanisms and thus probe the interstellar medium and the distribution of cosmic rays, magnetic fields, radiations, and low luminosity X-ray sources in the Galaxy. The data were selected to remove errors, earth or horizon events, and trapped or precipitating particles. Each azimuthal accumulation was rebinned into fixed energy bins, taking account of the variable instrument gain from orbit to orbit, and into a system of one square degree spatial bins fixed in galactic coordinates, in such a way as to preserve the full space and energy resolution of the instrument. The instrumental and isotropic X-ray background was determined for each orbit from those bins of the scan circle that were away from known strong X-ray sources. The results were summed into two-dimensional maps of the sky. Dissert. Abstr.

N77-11964 California Inst. of Tech., Pasadena.
A LIMIT ON THE INHOMOGENEITY OF THE COSMIC MICROWAVE BACKGROUND RADIATION AT AN ANGULAR SCALE OF 1.25 ARCMIN Ph.D. Thesis
Jay Cee Pigg, Jr. 1976 63 p
Avail: Univ. Microfilms Order No. 76-23116

An observational upper limit to the inhomogeneity of the cosmic background radiation on an angular scale of 1.25 arcmin was obtained at a wavelength of 2.0 cm. This and Pariiskii's limit at 22 arcmin define the observational upper limit to delta tau/tau for all scales 1 deg or less. Constraints are placed on published models of galaxy formation and 1000-Mpc scale clustering. Hypotheses that fluctuations in the background radiation could be caused by random fluctuations in the number of protogalaxies in a given solid angle, and that reionization of the intergalactic medium could be associated with the collapse of protogalaxies are shown to be consistent with the observations. Any discrete source model for the origin of the radiation would require more than 100 times as many sources as there are galaxies. Dissert. Abstr.

N77-11965*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RELATIONSHIP BETWEEN THE GALACTIC MATTER DISTRIBUTION, COSMIC RAY DYNAMICS, AND GAMMA RAY PRODUCTION
D. A. Kniffen, C. E. Fichtel, and D. J. Thompson Nov. 1976 36 p refs Submitted for publication
(NASA-TM-X-71224; X-662-76-246) Avail: NTIS HC A03/MF A01 CSCL 03B

Theoretical considerations and analysis of the results of gamma ray astronomy suggest that the galactic cosmic rays are dynamically coupled to the interstellar matter through the magnetic fields, and hence the cosmic ray density should be enhanced where the matter density is greatest on the scale of galactic arms. This concept has been explored in a galactic model using recent 21 cm radio observations of the neutral hydrogen and 2.6 mm observations of carbon monoxide, which is considered to be a tracer of molecular hydrogen. The model assumes: (1) cosmic rays are galactic and not universal; (2) on the scale of galactic arms, the cosmic ray column (surface) density is proportional to the total interstellar gas column density; (3) the cosmic ray scale height is significantly larger than the scale height of the matter; and (4) ours is a spiral galaxy characterized by an arm to interarm density ratio of about 3:1. Author

N77-11966# Aerospace Corp., El Segundo, Calif. Lab. Operations.
A QUASI-LINEAR KINETIC EQUATION FOR COSMIC RAYS IN THE INTERPLANETARY MEDIUM Interim Report
J. G. Luhmann 25 Mar. 1976 27 p refs
(Contract F04701-75-C-0076)
(AD-A023849; TR-0076(6260-20)-10; SAMSO-TR-76-72)
Avail: NTIS HC A03/MF A01 CSCL 03/2

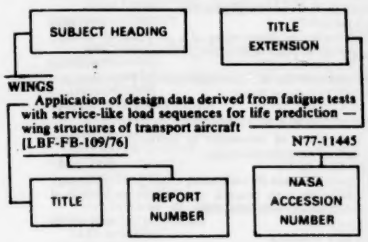
A kinetic equation for interplanetary cosmic rays is set up with the aid of weak plasma turbulence theory for an idealized radially symmetric model of the interplanetary magnetic field. As a starting point, this treatment invokes the Vlasov equation instead of the traditional Fokker-Planck equation. Quasilinear theory is applied to obtain a momentum diffusion equation, for the heliocentric frame of reference, which describes the interaction of cosmic rays with convecting magnetic irregularities in the solar wind plasma. Under restricted conditions, the well known equation of solar modulation can be obtained from the kinetic equation. GRA

99 GENERAL

No abstracts in this category.

SUBJECT INDEX

Typical Subject Index Listing



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A

ABSORBENTS
Development of a prototype regenerable carbon dioxide absorber
[NASA-CR-137919] N77-11677
ABSORBERS [MATERIALS]
Development of a prototype regenerable carbon dioxide absorber
[NASA-CR-137919] N77-11677
ACCELERATION [PHYSICS]
Ventricular pathology in swine at high sustained +G sub z
N77-11646
Psycho-physiological and physio-chemical assessment of acceleration induced changes in humans positioned in various seatback angle configurations
N77-11647
Coronary flow and myocardial biochemical responses to high sustained +G sub z acceleration
N77-11649
ACCELERATION STRESSES [PHYSIOLOGY]
The pathophysiology of high sustained +G sub z acceleration, limitation to air combat manoeuvering and the use of centrifuges in performance training
[AGARD-CP-189] N77-11644
Effect of sustained +G sub z acceleration on cardiac output and fractionation of cardiac output in awake miniature swine
N77-11650
ACCELERATION TOLERANCE
Centrifuge assessment of a reclining seat
N77-11648
Utilization of human centrifuge for training military pilots in the execution of protective straining maneuvers
N77-11651
ACOUSTIC ATTENUATION
Measurement and prediction of sound attenuation by highway barriers using acoustic modeling techniques
N77-11812
ACOUSTIC MEASUREMENTS
Acoustical evaluation of the NASA Langley V/STOL wind tunnel
[NASA-CR-145087] N77-11068
Measurement and prediction of sound attenuation by buildings using acoustic modeling techniques
N77-11814
ACOUSTIC PROPERTIES
Acoustical evaluation of the NASA Langley V/STOL wind tunnel
[NASA-CR-145087] N77-11068
ACOUSTIC SCATTERING
Scattering from large planar gratings of compliant cylindrical shells
[AD-A025279] N77-11820
ACOUSTIC VELOCITY
Mathematical models of acoustic and acoustic-gravity wave propagation in fluids with height-dependent sound velocities
N77-11813
ACOUSTICS
Experimental and analytical study of thermal acoustic oscillations — in the transfer and storage of cryogens
[NASA-CR-150051] N77-11212
ACOUSTO-OPTICS
Differential optoacoustic absorption detector
[NASA-CASE-NPO-13759-1] N77-11363
ACTIVATION [BIOLOGY]
Aerobic biological treatment of a colloidal wastewater
N77-11568
ACTIVATION ENERGY
Diffusion in transition metals and alloys and selective adsorption and hydrogen embrittlement
N77-11144
ACTUATORS
Design and fabrication of an 8000 PSI control-by-wire actuator for flight testing in a T-2 C airplane
[AD-A024487] N77-11065
ADAPTIVE CONTROL
Transient behavior of an adaptive array
N77-11250
The stabilization of bilinear systems and its application to the discrete model reference adaptive control
N77-11754
Adaptive computer-assisted tutorials: A cybernetic approach optimization with finite-state machines
[AD-A024252] N77-11758
ADDITIVES
Development of processes for simultaneous diffusion of several dopant junction or doping elements for power devices
[BMFT-FB-T-76-16] N77-11305
ADHESIVE BONDING
Mechanisms of adhesion failure between polymers and metallic substrates. Part 2: Aluminum 2024-T3 and titanium 6Al4V with HT424 adhesive
[AD-A025256] N77-11183
Weld-bonded titanium structures
[NASA-CASE-LAR-11549-1] N77-11397
Research on adhesive bonding and surface characteristics of metals at Fokker-VFW
[FOK-R-1816] N77-11405
ADHESIVES
Rate and time dependent behavior of structural adhesives
N77-11112
ADIABATIC CONDITIONS
The electron beam fluorescence technique applied to hypersonic turbulent flows
N77-11236
ADJUSTING
The least squares collocation from the adjustment point of view and related topics
[AD-A024203] N77-11628
AERIAL PHOTOGRAPHY
The use of remote sensing devices for acquiring data for environmental management purposes. Report 2: Application of photographic remote sensors to an environmental management problem
[AD-A025616] N77-11519
AEROBES
Aerobic biological treatment of a colloidal wastewater
N77-11568
AERODYNAMIC BALANCE
Systematic study of error sources in supersonic skin-friction balance measurements
[NASA-TN-D-8291] N77-11339
AERODYNAMIC CHARACTERISTICS
Aerodynamic characteristics of a 0.00563 scale 142-inch diameter solid rocket booster [MSFC model 449 and 480] with side mounted stings in the NASA/MSFC 14-inch trisonic wind tunnel [SA14FA]
[NASA-CR-147645] N77-11000
Calculation of the longitudinal aerodynamic characteristics of wing-flap configurations with externally blown flaps
[NASA-CR-2705] N77-11006
Small axial compressor technology, volume 1
[NASA-CR-134827-VOL-1] N77-11048
Small axial compressor technology, volume 2 — tables
[NASA-CR-134827-VOL-2] N77-11049
An investigation of the aerodynamic characteristics of a 0.00548 scale model [model no. 486] of the space shuttle 146-inch diameter solid rocket booster at angels of attack from 113 deg to 180 deg in the AEDC PWT 4-foot transonic wind tunnel [SA16F]
[NASA-CR-147648] N77-11090
Laser velocimetry applied to transonic and supersonic aerodynamics N77-11224
Multidimensional difference schemes with fourth order accuracy
[AD-A023766] N77-11771
AERODYNAMIC COEFFICIENTS
Prediction of the drag coefficient of a 20-degree conical ribbon parachute
[NASA-CR-150056] N77-11003
AERODYNAMIC CONFIGURATIONS
A computational system for aerodynamic design and analysis of supersonic aircraft. Part 2: User's manual
[NASA-CR-2716] N77-11005
AERODYNAMIC DRAG
Prediction of the drag coefficient of a 20-degree conical ribbon parachute
[NASA-CR-150056] N77-11003
AERODYNAMIC FORCES
Systematic study of error sources in supersonic skin-friction balance measurements
[NASA-TN-D-8291] N77-11339
AERODYNAMIC HEAT TRANSFER
Heat-transfer tests on the Rockwell International space shuttle orbiter with boundary-layer trips [OH-54]
[AD-A024553] N77-11098
AERODYNAMIC HEATING
A device for rapid determination of thermophysical properties of phase-change wind-tunnel models
[NASA-TM-X-3421] N77-11346
AERODYNAMIC INTERFERENCE
The effect of finite test section length on wall interference in 2-D ventilated wind tunnels
[NLR-MP-75036-U] N77-11071
AERODYNAMICS
Project SQUID: A cooperative program of fundamental research related to jet propulsion
[AD-A024004] N77-11059
Investigating complex aerodynamic flows with a laser velocimeter
[NASA-TM-X-73171] N77-11390
AERONAUTICAL ENGINEERING
Aircraft fuel conservation technology. Task force report, September 10 1975
[NASA-TM-X-74295] N77-11055
AEROSOLS
Preliminary aerosol generator design studies
[NASA-CR-150050] N77-11081
Optical method for measuring the mass concentration of particulate emissions
[PB-255093/7] N77-11384
Total suspended particulates: Review and analysis
[PB-255858/3] N77-11574
Determination and possible public health impact of transition metal sulfite aerosol species
[PB-255407/9] N77-11590
Global measurements of gaseous and aerosol trace species in the upper troposphere and lower stratosphere from daily flights of 747 airliners
[NASA-TM-X-73544] N77-11612
AEROSPACE ENGINEERING
Vocabulary of aerospace safety terms pertaining to cryogenic safety, fires, explosions, and structure failure
[NASA-TM-X-73521] N77-11901
AEROSPACE ENVIRONMENTS
Local temperatures in semigray nondiffuse cones and V-grooves
N77-11341
Meteorological regimes for the classification of aerospace air quality predictions for NASA-Kennedy Space Center
[NASA-TM-X-3450] N77-11570
AEROSPACE MEDICINE
Psycho-physiological and physio-chemical assessment of acceleration induced changes in humans positioned in various seatback angle configurations
N77-11647

The use of a fixed base simulator as a training device for high sustained or ACM [Air Combat Maneuvering] +G sub z stress N77-11652

AEROSPACE SCIENCES
Space is for man [NASA-TT-F-16254] N77-11075

AGGREGATES
Comparison of 4-1/2- and 7-in. [6-in. nominal] maximum size aggregate mixtures for new lock and dam no. 26, Mississippi River [AD-A023968] N77-11455
Concrete aggregate durability tests [PB-255436/8] N77-11457
Influence of mica on the compaction and bearing properties of base course aggregate [VTI-55] N77-11920

AGRICULTURE
Application of remote sensing techniques for the study and evaluation of natural resources in Peru [E77-10024] N77-11487

AIR CONDITIONING
National program for solar heating and cooling [residential and commercial applications] [ERDA-23A] N77-11540

AIR FILTERS
Evaluation of Rexnord gravel bed filter [PB-255095/2] N77-11597

AIR POLLUTION
Performance and emission characteristics of swirl-can combustors to near-stoichiometric fuel-air ratio [NASA-TN-D-8342] N77-11056
Asphalt hot-mix emission study [PB-250504/8] N77-11542
Catalytic reduction of nitric oxide with carbon monoxide by rare earth oxides and noble metal catalysts N77-11567
Evaluation of satellites and remote sensors for atmospheric pollution measurements [NASA-CR-144970] N77-11569
Total suspended particulates: Review and analysis [PB-255858/3] N77-11574
Regression using hockey stick functions [PB-253576/3] N77-11576
Analysis of the data from the three-dimensional gradient study --- for atmospheric pollutant layers diffusion [PB-253936/9] N77-11578
Air pollution monitoring at the Redcar site: Measurement of grit and dust [3d] [PB-254199/3] N77-11579
Field test sampling/analytical strategies and implementation cost estimates: Coal gasification and flue gas desulfurization [PB-254166/2] N77-11581
Technical manual for measurement of fugitive emissions: Upwind/downwind sampling method for industrial emissions [PB-253092/1] N77-11585
An evaluation of high altitude engine modification devices [econo-kit] [PB-255556/3] N77-11589
Determination and possible public health impact of transition metal sulfite aerosol species [PB-255407/9] N77-11590
West Virginia power plant evaluation [PB-255460/8] N77-11592
Design of pollutant-oriented integrated monitoring systems. A test case: Environmental lead [PB-255103/4] N77-11595
Particulate collection efficiency measurements on an electrostatic precipitator installed on a paper mill recovery boiler [PB-255297/4] N77-11596
Evaluation of Rexnord gravel bed filter [PB-255095/2] N77-11597
Airborne LIDAR Raps studies, February 1974 --- for computerized air pollution monitoring [PB-255886/4] N77-11601
Investigation and assessment of light-duty-vehicle evaporative emission sources and control [PB-255813/8] N77-11603
Sulfur dioxide interference in the measurement of ambient particulate sulfates, volume 2 [PB-254427/8] N77-11607
A new atmospheric diffusion model N77-11609
Global measurements of gaseous and aerosol trace species in the upper troposphere and lower stratosphere from daily flights of 747 airliners [NASA-TM-X-73544] N77-11612
Design, development, fabrication and testing of a portable self-contained respirable dust mass monitor [PB-254503/6] N77-11681
Optics research --- report on laser technology and propagation and pollution studies [AD-A025338] N77-11856

AIR QUALITY
MIUS systems analysis: Effects of unfavorable meteorological conditions and building configurations on air quality [ONRL/HUD/MIUS-29-ADD-2] N77-11571
The air quality and economic implications of supplementary control systems in Illinois --- considering electric power plant fuels [PB-255699/1] N77-11588
Regional air pollution study: Quality assurance audits [PB-255313/9] N77-11605
Guidelines for air quality maintenance planning and analysis. Volume 14. Designated air quality maintenance areas [PB-254961/6] N77-11606

AIR SAMPLING
A spiral sequential sampler for air and liquids, preliminary results [PB-255435/0] N77-11386
Regional air pollution study: Quality assurance audits [PB-255313/9] N77-11605
Sulfur dioxide interference in the measurement of ambient particulate sulfates, volume 2 [PB-254427/8] N77-11607

AIR TO AIR MISSILES
Optimal multiple-arc trajectories for an all-aspect air-to-air missile N77-11082

AIR TRAFFIC CONTROL
The establishment of safe separations between aircraft in flight [NLR-MP-75041-U] N77-11020

AIR TRANSPORTATION
Toward new heights --- air transportation in the Soviet Union [NASA-TT-F-17248] N77-11019

AIRCRAFT ANTENNAS
Airborne antenna polarization study for the microwave landing system [NASA-TM-X-73952] N77-11266
Thin conformal antenna array for microwave power conversion [NASA-CASE-NPO-13886-1] N77-11269
Dual band airborne antenna test program [AD-A024024] N77-11275

AIRCRAFT DESIGN
Preliminary sizing and performance evaluation of supersonic cruise aircraft [NASA-TM-X-73936] N77-11031

AIRCRAFT ENGINES
Performance of 1.15-pressure-ratio fan stage at several rotor blade setting angles with reverse flow [NASA-TM-X-3451] N77-11008
Bosch technical instruction. Gasoline injection D and L-jetronic [NASA-TT-F-17111] N77-11399

AIRCRAFT FUEL SYSTEMS
Aircraft fuel conservation technology. Task force report, September 10 1975 [NASA-TM-X-74295] N77-11055
Reduction of gaseous pollutant emissions from gas turbine combustors using hydrogen-enriched jet fuel [NASA-CR-149146] N77-11198

AIRCRAFT HYDRAULIC SYSTEMS
Power transfer units for aircraft hydraulic systems [AD-A024446] N77-11058

AIRCRAFT LANDING
A flight investigation of piloting techniques and crosswind limitations during visual STOL-type landing operations [NASA-TN-D-8284] N77-11001
Landing practices of general aviation pilots in single-engine light airplanes [NASA-TN-D-8283] N77-11033
Revised aircraft load curves and vehicle ice-thickness tables for annual ice sheet operations near McMurdo, Antarctica [AD-A024051] N77-11461

AIRCRAFT MAINTENANCE
Bearing restoration by grinding [NASA-CR-149188] N77-11404

AIRCRAFT MANEUVERS
The pathophysiology of high sustained +G sub z acceleration, limitation to air combat manoeuvering and the use of centrifuges in performance training [AGARD-CP-189] N77-11644
The use of a fixed base simulator as a training device for high sustained or ACM [Air Combat Maneuvering] +G sub z stress N77-11652
Stress response and stress tolerance in fighter pilots during 6 G manoeuvers N77-11653

AIRCRAFT MODELS
A wind tunnel captive aircraft testing technique [AD-A023690] N77-11037

AIRCRAFT NOISE
V/STOL aircraft noise prediction [jet propulsors] --- computer program [AD-A028765/6] N77-11045
Airport noise monitoring systems, task A [AD-A028511/4] N77-11821

AIRCRAFT PERFORMANCE
Final approach performance monitor [AD-A028513/0] N77-11024

AIRCRAFT PILOTS
Rationale and description of a coordinated cockpit display for aircraft flight management [NASA-TM-X-3457] N77-11044
Stress response and stress tolerance in fighter pilots during 6 G manoeuvers N77-11653

AIRCRAFT RELIABILITY
Helicopter reliability growth evaluation [AD-A025265] N77-11041

AIRCRAFT SAFETY
Aircraft ground fire suppression and rescue systems. Characteristics of kinematic jet fuel fires cascading and rod fuel geometries [AD-A024447] N77-11022
Rationale and description of a coordinated cockpit display for aircraft flight management [NASA-TM-X-3457] N77-11044
Conference on the Development of Fire-Resistant Aircraft Passenger Seats [NASA-TM-X-73144] N77-11111

AIRCRAFT STRUCTURES
Compilation of measures to increase the fatigue strength of aircraft structures [LBF-TB-126/75] N77-11447
Current practice on estimating crack growth damage accumulation with specific application to structural safety durability and reliability [AD-A025499] N77-11478

AIRCRAFT WAKES
Effects of jets, wakes, and vortices on lifting surfaces [NASA-TM-X-73974] N77-10998
Development of predictive wake vortex transport model for terminal area wake vortex avoidance [AD-A029049/4] N77-11002
Holographic flow visualization --- of aircraft wakes [NASA-CR-149182] N77-11365

AIRFOILS
Viscous interaction with separation in transonic flow [NASA-TT-F-17187] N77-10997

AIRFRAME MATERIALS
Mechanism of material fatigue during the crack initiation stage [ICAF-DOC-895] N77-11441

AIRFRAMES
Calculation of multi-contour thin-walled structures by the method of sections [NASA-TT-F-17284] N77-11029

AIRPORTS
Airport noise monitoring systems, task A [AD-A028511/4] N77-11821

AIRSPACE
The establishment of safe separations between aircraft in flight [NLR-MP-75041-U] N77-11020

AIRSPEED
Army preliminary evaluation YOH-58A helicopter with a flat-plate canopy [AD-A024501] N77-11039
Effects of forward velocity on noise for a J85 turbojet engine with multitube suppressor from wind tunnel and flight tests [NASA-TM-X-73542] N77-11051

ALGOL
An ALGOL program for the calculation of incompressible three dimensional turbulent boundary layers [NLR-TR-74159-U] N77-11010

ALGORITHMS
Parametric study of predictor accuracy impact on OFT rendezvous targeting [NASA-CR-151094] N77-11078
Implications of alloy structure with respect to mechanical properties [AD-A023832] N77-11164
Graphics system modeling: Verification and applications [AD-A024068] N77-11699
Fast sequential decoding and a new complete decoding algorithm N77-11705
An algorithm for synthesis of combinational logic using decomposition and probability N77-11706
The complexity of parallel algorithms N77-11707
A study of fast transform algorithms N77-11709
System identification techniques using the group method of data handling N77-11713
Computational algorithms for coding bound exponents N77-11715
Use of synthetic benchmarks for estimating service bureau processing charges [PB-255054/9] N77-11726
An optimal algorithm for testing random access memories [AD-A023894] N77-11732
Multi-parametric mathematical programming problems [AD-A025715] N77-11741

Parallel multitonic sorting networks
[AD-A024392] N77-11749
Associative processing of network flow problems
[AD-A024380] N77-11750
Knowledge acquisition from structural descriptions
[AD-A025074] N77-11759
Integration-free interval doubling for Riccati equation solutions
[NASA-CR-149145] N77-11763
Explicit inverses of some special matrices [with a few computer programs]
[ORNL-CSD-2] N77-11765
Some iterative procedures to obtain nonlinear least squares estimates
[AD-A024437] N77-11768
Analysis of a simple factorization algorithm
[AD-A024416] N77-11790
Advanced dial-a-ride algorithms research project
[PB-254752/9] N77-11922

ALKALINE BATTERIES
Evaluation of potassium titanate as a component of alkaline fuel cell matrices
[NASA-TN-D-8341] N77-11175

ALLOYS
Metalhydrides
[OUEL-1146/76] N77-11158
Implications of alloy structure with respect to mechanical properties
[AD-A023832] N77-11164

ALPHABETS
Comparison of human information processing performance with DOT and stroke alphabetic characters
[AD-A024099] N77-11686

ALUMINATES
Ionic conductivity in the sodium gallates
N77-11872

ALUMINUM
Effect of fiber diameter and matrix alloys on impact-resistant boron/aluminum composites
[NASA-TN-D-8204] N77-11118

ALUMINUM ALLOYS
Corrosion behaviour of mixed laminates [CFRP core with both 7075-T6 clad and 5052-H38 faces]
[FOK-R-1868] N77-11121
Hot hardness of nickel-rich nickel-chromium-aluminum alloys
[NASA-TM-X-3429] N77-11155
Computer-aided design and manufacturing for extrusion of aluminum, titanium, and steel structural parts [phase 1]
[AD-A023946] N77-11171
Mechanisms of adhesion failure between polymers and metallic substrates. Part 2: Aluminum 2024-T3 and titanium 6Al4V with HT424 adhesive
[AD-A025256] N77-11183
Fracture toughness tests on compressive preloaded specimens with a thickness of 5 mm — in crack presence
[FOK-R-1839] N77-11448

ALUMINUM OXIDES
Preparation and properties of beta-alumina/glass composites
[PB-255549/8] N77-11130
Study of erosion mechanisms of engineering ceramics
[AD-A025258] N77-11184

AMINES
Electrochemical analysis of sulfidic and amine odorants
[PB-255092/9] N77-11591

AMORPHOUS MATERIALS
Static magnetic properties of DC biased RF sputtered GdFe amorphous films
N77-11871

AMPLITUDE MODULATION
Response of linear discrete systems to modulated sequences
N77-11258

ANALOG COMPUTERS
Analog computation assessment of the risk of structural failure due to crack growth under random loading
[AD-A025266] N77-11042
Computer control of distillation column containing analog overrides
N77-11703

ANALOG DATA
Nonvolatile analog memories with ferroelectric elements
[BMFT-FB-T-76-11] N77-11302

ANALOG TO DIGITAL CONVERTERS
Centroid and moments of an area using a digitizer
[NASA-TM-X-73528] N77-11718

ANALYSIS [MATHEMATICS]
Solution of networks containing a trichotomized class of elements
N77-11714

ANALYSIS OF VARIANCE
Analysis of unified testing theory — reliability testing for munition components
[AD-A023872] N77-11791

ANECHOIC CHAMBERS
Simulation of flight-type engine fan noise in the NASA-Lewis 9X15 anechoic wind tunnel
[NASA-TM-X-73540] N77-11050

ANEMOMETERS
Review on high speed applications of laser anemometry in France and Germany
N77-11222
The application of a laser anemometer to the investigation of shock-wave boundary-layer interactions
N77-11226
Development of photon correlation anemometry for application to supersonic flows
N77-11231
The time-of-flight laser anemometer
N77-11243
Comparison of laser anemometry methods of several laboratories. Report on ISL measurements carried out 5 - 8 November 1974 — two-focus and Doppler anemometry
[ISL-R-129/75] N77-11374

ANGLE OF ATTACK
Heat-transfer distributions on a 0.013-scale shuttle solid rocket booster at Mach 3.70 and angles of attack from 0 deg to 180 deg
[NASA-TM-X-3417] N77-10995
Influence of aircraft angle of attack on high G cockpit design
[AD-A025083] N77-11043
Angle detector
[NASA-CASE-ARC-11036-1] N77-11364

ANGULAR CORRELATION
Investigation of critical phenomena in nickel through perturbed angular correlation experiments
N77-11147

ANGULAR MOMENTUM
Electronic angular momentum transfer in the I[doublet P[1/2]] + NF [a singlet delta] system
[AD-A024258] N77-11833

ANGULAR RESOLUTION
Compressor blade setting angle accuracy study, volume 1
[NASA-CR-135068-VOL-1] N77-11046
A limit on the inhomogeneity of the cosmic microwave background radiation at an angular scale of 1.25 arcmin
N77-11964

ANISOTROPIC MEDIA
Beam propagation and guiding in anisotropic media, layers and fibers
N77-11869

ANNUAL VARIATIONS
Comment on 'Kp dependence on sectors, by I. B. McDiarmid and E. E. Budzinski
[NASA-CR-149176] N77-11624

ANTENNA ARRAYS
Analysis of arbitrarily oriented thin wire antenna arrays over imperfect ground planes
N77-11254
Thin conformal antenna array for microwave power conversion
[NASA-CASE-NPO-13886-1] N77-11269

ANTENNA COMPONENTS
Advanced hardened antenna window materials study 4
[AD-A023944] N77-11128
Stress analysis of Navy VLF antenna insulators
[AD-A024054] N77-11312

ANTENNA RADIATION PATTERNS
Analysis of arbitrarily oriented thin wire antenna arrays over imperfect ground planes
N77-11254
Dual band airborne antenna test program
[AD-A024024] N77-11275
Antenna mathematical modeling [GTD]
[AD-A025259] N77-11282
Antenna prediction computer problems
[AD-A024552] N77-11734

ANTENNAS
Ground resistance for MF/HF design analysis of grounded antenna systems
[AD-A025090] N77-11281
Charge and current distributions on, and input impedance of moderately fat transmitting crossed-monopole antennas
[AD-A025429] N77-11283

ANTIREFLECTION COATINGS
Optimized selective coatings for solar collectors
[NASA-TM-X-73498] N77-11529

ANTISEPTICS
Virion aggregation and disinfection of water viruses by bromine
[PB-253087/1] N77-11642

ANTISUBMARINE WARFARE AIRCRAFT
Catapult launch fatigue investigation of the model S-2 E airplane
[AD-A024071] N77-11038

ANTITANK MISSILES
Specifications of the propulsion systems for antitank rockets
N77-11187

APOLLO SOYUZ TEST PROJECT
ASTP chemical and microbiological analysis of potable water
[NASA-TM-X-58192] N77-11675

APOLLO 17 FLIGHT
The Apollo 17 infrared scanning radiometer
N77-11950

APPLICATIONS OF MATHEMATICS
Contributions to WKB theory
N77-11891

APPLICATIONS PROGRAMS [COMPUTERS]
Graphics system modeling: Verification and applications
[AD-A024068] N77-11699

APPROACH CONTROL
Detailed design specification for the ALT Shuttle Information Extraction Subsystem [SIES]
[NASA-CR-151097] N77-11091

APPROXIMATION
Discrete modeling and analysis of switching regulators
N77-11287
Approximation and interpolation by inner functions
N77-11761
Mixed-hybrid finite element approximations of second-order elliptic boundary-value problems
[ORO-3443-59] N77-11766
A note on distribution-free tolerance limits
[AD-A024137] N77-11788
On approximating and bounding GI/M/c queues
[AD-A023975] N77-11798

AQUIFERS
Geological and environmental resources investigations in Egypt using LANDSAT images
[E77-10039] N77-11499
Development assessment of wash water reclamation
[NASA-CR-137934] N77-11676

ARCHITECTURE
A hierarchical restructurable multi-microprocessor architecture
N77-11692

ARCHITECTURE [COMPUTERS]
Research on automatic programming
[AD-A024335] N77-11728

ARGON PLASMA
An experimental and theoretical study of the propagation of high amplitude pulses in a bounded magneto-plasma
N77-11861

ARIZONA
Polymer pavement concrete for Arizona study 2
[PB-255692/6] N77-11470

ARM [ANATOMY]
Control and trajectory optimization of a robot arm
[AD-A023669] N77-11688

ARRAYS
ROM programmable cellular array
N77-11289

ARSENIDES
Investigation of electronic transport, recombination and optical properties in In As sub 1-x P sub x alloy systems
[AD-A025294] N77-11889

ARTIFICIAL INTELLIGENCE
Some data-base applications of constraint expressions
[AD-A024149] N77-11727
Practical natural language processing. The REL system as prototype
[AD-A024313] N77-11731
Speculation on the evolution of intelligence and its possible realization in machine form
N77-11752

ARTILLERY
Specifications of the propulsion systems for antitank rockets
N77-11187

ARTILLERY FIRE
Impulsive noise measurement methods and physiological effects
N77-11196

ASPHALT
Asphalt hot-mix emission study
[PB-250504/8] N77-11542

ASTRONAUTS
Equipment for the cosmonaut
[NASA-TT-F-17275] N77-11670

ASTRONOMICAL COORDINATES
Star catalogues and their significance to geodesy of the 1980's
[AD-A024156] N77-11938

ASTRONOMICAL MAPS
Star catalogues and their significance to geodesy of the 1980's
[AD-A024156] N77-11938

ASTRONOMICAL MODELS
Studies in gravitation
N77-11610

ASTRONOMICAL TELESCOPES
The detection capabilities of gallium arsenide and s-20 photo-multiplier tubes to go-type, point-source, signals
[AD-A023818] N77-11314

ASTROPHYSICS
Neutrino astrophysics
[NASA-TT-F-17249] N77-11946
The relationship between the galactic matter distribution, cosmic ray dynamics, and gamma ray production
[NASA-TM-X-71224] N77-11965

ASYMPTOTIC METHODS
Analysis of the perturbed motion of asymmetric, spinning spacecraft
[NLR-TR-75043-U] N77-11097

ATELECTASIS
Centrifuge assessment of a reclining seat
N77-11648

ATMOSPHERIC ATTENUATION
Study of acoustic wave propagation in the atmosphere. Feasibility of an experimental study in the ISL sonic boom generator
[ISL-4/74] N77-11819

ATMOSPHERIC CHEMISTRY
Preliminary report on electron energy-loss measurements for CClF3, CCl2F2, and CCl3F
[PB-255227/1] N77-11630

ATMOSPHERIC CIRCULATION
An investigation of optically relevant turbulence parameters in the marine boundary layer
[AD-A025421] N77-11631

ATMOSPHERIC CONDUCTIVITY
Large scale atmospheric electric fields: Comparisons with balloon data
N77-11608

ATMOSPHERIC DENSITY
A new atmospheric model and earth-satellite motion
[NASA-TT-F-17108] N77-11614

ATMOSPHERIC DIFFUSION
Meteorological regimes for the classification of aerospace air quality predictions for NASA-Kennedy Space Center
[NASA-TM-X-3450] N77-11570
A new atmospheric diffusion model
N77-11609
The covariance of temperature and ozone due to planetary-wave forcing
[NASA-TM-X-71212] N77-11613

ATMOSPHERIC MODELS
Development of predictive wake vortex transport model for terminal area wake vortex avoidance
[AD-A029049/4] N77-11002
Analysis of the data from the three-dimensional gradient study --- for atmospheric pollutant layers diffusion
[PB-253936/9] N77-11578
A new atmospheric model and earth-satellite motion
[NASA-TT-F-17108] N77-11614
Assimilation of surface, upper air, and grid-point data in the objective analysis procedure for a three-dimensional trajectory model
[PB-256082/9] N77-11638
Modeling dynamic processes in planetary atmospheres. Part 1: Apparatus for studying shear flow stability in spherical layers, preliminary results
[NASA-TT-F-17262] N77-11951

ATMOSPHERIC PHYSICS
Earth and ocean modeling
[NASA-CR-150055] N77-11617

ATMOSPHERIC TEMPERATURE
The covariance of temperature and ozone due to planetary-wave forcing
[NASA-TM-X-71212] N77-11613
Water vapor in the lower stratosphere measured from aircraft flight
[NASA-TM-X-71220] N77-11618
Tests and evaluations of CLRX, the diagnosis of clear-column radiances
[AD-A023908] N77-11622
An investigation of optically relevant turbulence parameters in the marine boundary layer
[AD-A025421] N77-11631

ATMOSPHERIC TURBULENCE
Investigation of the effects of nonhomogeneous [or nonstationary] behavior on the spectra of atmospheric turbulence
[NASA-CR-2745] N77-11034

ATOMIC COLLISIONS
Comment on A paradox: The thermal rate coefficient for the H + DCl yields HCl + D exchange reaction
[AD-A023896] N77-11139

ATOMIC ENERGY LEVELS
Future directions for beam-foil spectroscopy
[NASA-CR-149177] N77-11138

ATOMIC EXCITATIONS
Investigation of critical phenomena in nickel through perturbed angular correlation experiments
N77-11147

ATOMIC RECOMBINATION
Absolute rate of the reaction of C I[2P] with methane from 200-500 K
[NASA-TM-X-71221] N77-11136

ATOMIC SPECTRA
Future directions for beam-foil spectroscopy
[NASA-CR-149177] N77-11138

ATOMIC STRUCTURE
The ground state electronic structure of atomic boron
N77-11827
Hartree-Fock energy curves, for BrH[+][X[P2]I], KrH[+][X1 sigma [+]], and RbH[+][X 2 sigma [+]]
[UCRL-51738] N77-11831

ATTITUDE STABILITY
Nuclear-powered Hysat spacecraft: Comparative design study
[ERDA-SNS-3063-8] N77-11108

AUDIOMETRY
Influence of the peak pressure and duration of impulse noise [gun fire] on the hearing of the guinea pig
[ISL-R-109/75] N77-11639

AUDITORY FATIGUE
Influence of the peak pressure and duration of impulse noise [gun fire] on the hearing of the guinea pig
[ISL-R-109/75] N77-11639

AUDITORY PERCEPTION
Influence of a precursor noise on the global action potential consecutive to an impulse noise in the Guinea pig
[ISL-R-115/75] N77-11640
Predictive model of the auditory process as related to communication systems
[AD-A024300] N77-11656

AUDITORY STIMULI
Influence of the peak pressure and duration of impulse noise [gun fire] on the hearing of the guinea pig
[ISL-R-109/75] N77-11639
Study of metabolic response variation to an acoustic aggression --- metabolic recuperation after sonic boom N wave exposure
[ISL-R-120/75] N77-11641
S2 probability and CNV [Contingent Negative Variation] --- signal detection task and selective reaction time task
[IZF-1975-11] N77-11668

AURORAS
Earth magnetism, the aurora and ultralow-frequency radiation
[NASA-TT-F-16737] N77-11616

AUTOMATIC CONTROL
Display/control requirements for VTOL aircraft
[NASA-CR-145026] N77-11030

AUTOMATION
Research on automatic programming
[AD-A024335] N77-11728

AUTOMOBILE ENGINES
Ceramic materials and components for small automotive gas turbine engine
[AD-A025472] N77-11417
An evaluation of high altitude engine modification devices [econo-kit]
[PB-255556/3] N77-11589
Investigation and assessment of light-duty-vehicle evaporative emission sources and control
[PB-255813/8] N77-11603

AUTOMOBILES
Motor vehicle ignition radiation with respect to the SAE standard J551C
[PB-254187/8] N77-11273

AUTOMORPHISMS
Some results in majority decoding of binary cyclic codes
N77-11711

AVALANCHE DIODES
Destruction by avalanche burnout --- power diodes, noting IMPATT effect
[BMFT-FB-T-76-14] N77-11303
Manufacturing methods and technology engineering high efficiency high power gallium arsenide read-type IMPATT diodes
[AD-A023913] N77-11309

AXIAL FLOW
Compressor blade setting angle accuracy study, volume I
[NASA-CR-135068-VOL-1] N77-11046
Compressor blade setting angle accuracy study. Volume 2: Data compilation
[NASA-CR-135068-VOL-2] N77-11047

AXIAL LOADS
Axial xenon redistribution and power shaping in large pressurized water reactors
N77-11845

AXISYMMETRIC BODIES
Secondary flow in axisymmetric compressors
[NASA-TT-F-15497] N77-11009

B

BABBITT METAL
An experimental investigation of babbitt metal bonding
[AD-A024306] N77-11413

BACKGROUND RADIATION
A limit on the inhomogeneity of the cosmic microwave background radiation at an angular scale of 1.25 arcmin
N77-11964

BACTERICIDES
An evaluation of a fuel-soluble organoboron biocide for control of sulfate-reducing bacteria in shipboard fuel tanks
[AD-A024017] N77-11643

BALL BEARINGS
Spherical bearing
[NASA-CASE-MFS-23447-1] N77-11403
Bearing restoration by grinding
[NASA-CR-149188] N77-11404
Lubrication of bearings in vacuum. Examination of life-tested bearings from MSDS Ltd --- lead and grease lubricants
[T[F]S/128] N77-11407

BALLOON SOUNDING
Large scale atmospheric electric fields: Comparisons with balloon data
N77-11608

BALTIC SHIELD [EUROPE]
Use of satellite pictures for determining major shield fractures relevant for ore prospecting, northern Finland
[E77-10027] N77-11490

BAND STRUCTURE OF SOLIDS
KKR analysis of the Anderson-McMillan theory of electronic structure of liquid metals
[AD-A024386] N77-11887

BANDPASS FILTERS
The design of filters to have linear passband phase and arbitrary stopband loss
N77-11288
Photolithographic techniques for Surface Acoustic Wave [SAW] devices
[AD-A025492] N77-11822

BANDWIDTH
Phase scanned array bandwidth limitations in a wideband radar system
N77-11265

BANGLADESH
Investigations using data from LANDSAT-2 --- Bangladesh
[E77-10029] N77-11492

BAROTROPIC FLOW
The covariance of temperature and ozone due to planetary-wave forcing
[NASA-TM-X-71212] N77-11613

BARRIERS
Measurement and prediction of sound attenuation by highway barriers using acoustic modeling techniques
N77-11812

BATCH PROCESSING
Use of synthetic benchmarks for estimating service bureau processing charges
[PB-255054/9] N77-11726

BAYES THEOREM
Some aspects of bivariate regression subject to linear constraints --- in the Bayesian and sampling theory framework
[AD-A024255] N77-11794
A Bayesian approach to two-stage sampling
[AD-A025624] N77-11796

BEAMS [RADIATION]
Beam propagation and guiding in anisotropic media, layers and fibers
N77-11869
On the angular divergence of out-going beams in an asymmetric diffraction geometry
[PB-255865/8] N77-11886

BEAMS [SUPPORTS]
Simple thickness modes and shear correction coefficients for viscoelastic Timoshenko beams
[AD-A023771] N77-11125
Nonlinear periodic response of a slender beam-column
N77-11435
Analysis of reinforced concrete beams subjected to fire
[PB-256425/0] N77-11471

BEARING [DIRECTION]
Radio observations of interplanetary magnetic field structures out of the ecliptic
[NASA-TM-X-71223] N77-11947

BEARINGS
Isothermal elastohydrodynamic lubrication of point contacts. III: Fully flooded results
[NASA-TN-D-8317] N77-11400
Computer analysis of the performance of a swing-pad bearing with a compliant pad surface
[AD-A024418] N77-11414

BEDROCK
Use of satellite pictures for determining major shield fractures relevant for ore prospecting, northern Finland
[E77-10027] N77-11490

BEDS [PROCESS ENGINEERING]
Development studies on conversion of methanol and related oxygenates to gasoline
[FE-1773-14] N77-11202

BERYLLIUM OXIDES
Production engineering measures to manufacture super fine finish beryllia
[AD-A024470] N77-11315

BETA PARTICLES
Electrolytic hydrogen in beta titanium
N77-11146

BIBLIOGRAPHIES
Compilation of measures to increase the fatigue strength of aircraft structures
[LBF-TB-126/75] N77-11447

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[AD-A024600] N77-11902
The consequences of transit fare and service policies: A classified bibliography
[PB-253101/0] N77-11931

BINARY CODES
Some results in majority decoding of binary cyclic codes
N77-11711

BINARY DATA
Finite state equalization — bit by bit detection of the binary data sequence based on samples subject to interference and Gaussian noise
N77-11762

BINARY MIXTURES
Separations of multicomponent mixtures via thermal parametric pumping
N77-11328
A study of internal forced convective boiling heat transfer for binary mixtures
N77-11332

BIOCHEMICAL OXYGEN DEMAND
Coronary flow and myocardial biochemical responses to high sustained +G sub z acceleration
N77-11649

BIODEGRADATION
Heat treatment of refuse for increasing anaerobic biodegradability
[PB-252924/6] N77-11577

BIODYNAMICS
Paths of movement for selected body segments during typical pilot tasks
[AD-A025773] N77-11520
Principles of biodynamics. Volume 3: Physiological mechanisms in the mammal underlying posture, locomotion, and orientation in space
[AD-A023691] N77-11661

BIOENGINEERING
Investigation of the medical applications of the unique biocarbons developed by NASA
[NASA-CR-150061] N77-11916

BIOINSTRUMENTATION
Potential biomedical applications of ion beam technology
[NASA-TM-X-73512] N77-11655

BIOMEDICAL DATA
Biomedical technology transfer: Applications of NASA science and technology
N77-11915

BIOTELEMETRY
Biomedical technology transfer: Applications of NASA science and technology
N77-11915

BIRDS
Predictive model of the auditory process as related to communication systems
[AD-A024300] N77-11656

BITS
Finite state equalization — bit by bit detection of the binary data sequence based on samples subject to interference and Gaussian noise
N77-11762

BIVARIATE ANALYSIS
Some aspects of bivariate regression subject to linear constraints — in the Bayesian and sampling theory framework
[AD-A024255] N77-11794

BLACK HOLES [ASTRONOMY]
Accretion into and emission from black holes
N77-11940

BLACK SEA
Use of LANDSAT data for natural resources investigation in the lower basin of Danube and Danube Delta — Romania
[E77-10032] N77-11494

BLAST LOADS
Development of a computer program for the dynamic nonlinear response of reinforced concrete slabs under blast loading
[AD-A024050] N77-11458
Estimates of blowdown of quasi-static pressures in vented chambers
[AD-A025502] N77-11479
Estimating external blast loads from suppressive structures
[AD-A025503] N77-11480
Statistical model of sonic boom structural damage
[AD-A028512/2] N77-11818

BLUNT BODIES
Flow field in the wake of a blunt body by laser Doppler anemometry
N77-11245
Multidimensional difference schemes with fourth order accuracy
[AD-A023766] N77-11771

BOATTAILS
An improved projectile boattail, part 2
[AD-A024073] N77-11016

BODY KINEMATICS
Principles of biodynamics. Volume 3: Physiological mechanisms in the mammal underlying posture, locomotion, and orientation in space
[AD-A023691] N77-11661

BOILERS
Study of the feasibility of federal procurement of fuels produced from solid wastes
[PB-255695/9] N77-11513

BOILING
A study of internal forced convective boiling heat transfer for binary mixtures
N77-11332

BOLIVIA
The 29950 Earth Resource Technology Satellite [ERTS-A] sensor data for mineral resource sector development and regional land use survey, March - August 1976 — Bolivia
[E77-10028] N77-11491

BOLTZMANN TRANSPORT EQUATION
Iterative forward-adjoint Monte Carlo solutions of the Boltzmann transport equation
N77-11783

BONDING
Bond characteristics of model reinforcement
[PB-255847/6] N77-11473

BOOLEAN ALGEBRA
Probability measures on algebras
N77-11780

BORON
The ground state electronic structure of atomic boron
N77-11827

BORON-EPOXY COMPOUNDS
Program for establishing long-time flight service performance of composite materials in the center wing structure of C-130 aircraft. Phase 4: Ground/flight acceptance tests
[NASA-CR-145043] N77-11032
Strain rate effects on mechanical properties of fiber composites, part 3
[NASA-CR-135087] N77-11116

BOUNDARIES
Radiation from a collection of absorbing resonant systems in the presence of boundaries of intense fields
N77-11828

BOUNDARY LAYER CONTROL
The effects of wall temperature and suction on laminar boundary-layer stability
[AD-A025337] N77-11355

BOUNDARY LAYER FLOW
On the flow quality necessary for the Large European High-Reynolds-Number Transonic Windtunnel LEHRT
[AGARD-R-644] N77-11070

BOUNDARY LAYER SEPARATION
Controlled and uncontrolled flow separation in three dimensions
[LR-591] N77-10999
Performance and boundary-layer evaluation of a sonic inlet
[NASA-TN-D-8340] N77-11004
An experimental study of compressible turbulent boundary layer separation at high Reynolds numbers
N77-11321

BOUNDARY LAYER TRANSITION
Heat-transfer tests on the Rockwell International space shuttle orbiter with boundary-layer trips [OH-54]
[AD-A024553] N77-11098

BOUNDARY VALUE PROBLEMS
Mixed-hybrid finite element approximations of second-order elliptic boundary-value problems
[ORO-3443-59] N77-11766

BOX BEAMS
Hardboard-webbed I-beams subjected to short-term loading
[AD-A024507] N77-11465

BRAIN
The effect of 1.6 GHz radiation on neurotransmitters in discrete areas of the rat brain
[AD-A023677] N77-11662

BROADCASTING
Location variability of transmission loss: Land mobile and broadcast systems
[PB-254472/4] N77-11272

BROMINE
Virion aggregation and disinfection of water viruses by bromine
[PB-253087/1] N77-11642
Hartree-Fock energy curves, for BrH[+][X[P2]I], KrH[+][X1 sigma [+]], and RbH[+][X 2 sigma [+]]
[UCRL-51738] N77-11831

BROWNIAN MOVEMENTS
Brownian motion of interacting particles
N77-11824

BUILDINGS
Fire loads and live loads in buildings
[PB-255864/1] N77-11218
Examples of pressure coefficients measured on a tall building
[PB-252416/3] N77-11452
Commercial building unitary heat pump system with solar heating
[PB-255488/9] N77-11551
Measurement and prediction of sound attenuation by buildings using acoustic modeling techniques
N77-11814

C

C-130 AIRCRAFT
Program for establishing long-time flight service performance of composite materials in the center wing structure of C-130 aircraft. Phase 4: Ground/flight acceptance tests
[NASA-CR-145043] N77-11032

CABLES [ROPES]
Vibrations of suspended cables
N77-11427

CADMIUM SULFIDES
Applied research on II-VI compound
[PB-254637/2] N77-11547

CADMIUM TELLURIDES
Applied research on II-VI compound
[PB-254637/2] N77-11547

CALCIUM ISOTOPES
Studies of thick target fast neutron production and proton activation of the stable isotope tracer Ca-48 as applications of nuclear physics in medicine
N77-11837

CALCIUM OXIDES
Influence of Swedish building lime on the properties of fine grained soils for road construction
[VTI-41] N77-11918

CALIBRATING
Feasibility study of performing system calibration in an operate mode
[AD-A024744] N77-11026
Development of dynamic calibration methods for pogo pressure transducers — for space shuttle
[NASA-CR-149193] N77-11367
Modification of an NBS reference spectrophotometer
[PB-255539/9] N77-11381

CALIFORNIA
Follow-up study for the California resilience design method
[PB-255121/6] N77-11454

CANADA
Retransmission of hydrometric data in Canada
[E77-10041] N77-11501
Mandatory Canadian crude oil allocation regulations
[PB-255319/6] N77-11509
Research and development for Canadian nuclear power
[AECL-5314] N77-11533

CANONICAL FORMS
A canonical analysis of multiple time series
[AD-A023861] N77-11773

CANOPIES
Army preliminary evaluation YOH-58A helicopter with a flat-plate canopy
[AD-A024501] N77-11039

CAPACITORS
Thin film circuits for future applications. Part 1: Basic investigations and sputtering technique
[BMFT-FB-T-76-20] N77-11306

CAPE KENNEDY LAUNCH COMPLEX
Meteorological regimes for the classification of aerospace air quality predictions for NASA-Kennedy Space Center
[NASA-TM-X-3450] N77-11570

CARBON
Contributions to the study of the physical properties of carbon
[NASA-TT-F-17246] N77-11117
Carbon-carbon thermal structural response testing
[AD-A023919] N77-11129
On the kinetics and thermodynamics of metallic solid solutions
N77-11150

CARBON DIOXIDE
Development of a prototype regenerable carbon dioxide absorber
[NASA-CR-137919] N77-11677

CARBON DIOXIDE LASERS
Optical and laser-interferometric investigations of an electron-beam-controlled CO2-laser
[ISL-35/74] N77-11392

CARBON FIBER REINFORCED PLASTICS
Corrosion behaviour of mixed laminates [CFRP core with both 7075-T6 clad and 5052-H38 faces]
[FOK-R-1868] N77-11121

CARBON MONOXIDE
Development of fuel cell CO detection instruments for use in a mine atmosphere
[PB-254823/8] N77-11380
Catalytic reduction of nitric oxide with carbon monoxide by rare earth oxides and noble metal catalysts
N77-11567

CARBON STEELS
Embrittlement of carbon steels and iron by indium
N77-11149

CARDIAC VENTRICLES
Ventricular pathology in swine at high sustained +G sub z
N77-11646

CARDIOLOGY
Changes in clinical cardiologic measurements associated with high +G sub z stress
N77-11645

CARDIOVASCULAR SYSTEM
Effect of sustained +G sub z acceleration on cardiac output and fractionation of cardiac output in awake miniature swine
N77-11650
Cardiovascular, renal and respiratory effects of high intensity, intermediate duration, low frequency vibration
[AD-A025098] N77-11664

CASCADE CONTROL
Dynamics of inertia variant machinery
N77-11809

CASCADE WIND TUNNELS
Two-dimensional cold-air cascade study of a film-cooled turbine stator blade. 3: Effect of hole size on single-row and multirow ejection
[NASA-TM-X-3442] N77-11007

CASE HISTORIES
A review of case studies of technological innovations in state and local services
[PB-252914/7] N77-11926

CASTING
An experimental investigation of babbitt metal bonding
[AD-A024306] N77-11413

CATALOGS [PUBLICATIONS]
LANDSAT: US Standard Catalog, 1 - 30 June 1976
[NASA-TM-X-74219] N77-11506

CATALYSIS
Catalytic reduction of nitric oxide with carbon monoxide by rare earth oxides and noble metal catalysts
N77-11567

CATALYSTS
The initiator-activator relationship in the cold-cured polymerization of methylmethacrylate
[AD-A023678] N77-11179

CATALYTIC ACTIVITY
Steady-state multiplicity of catalytic reaction systems
N77-11132
Molecular clusters and catalytic activity
[AD-A024349] N77-11888

CATAPULTS
Fatigue investigation of the E-2B/C nose landing gear
[AD-A024072] N77-11040

CATHODE RAY TUBES
Rationale and description of a coordinated cockpit display for aircraft flight management
[NASA-TM-X-3457] N77-11044

CATHODES
Long lifetime hollow cathodes for 30-cm mercury ion thrusters
[NASA-TM-X-73523] N77-11101
Cycle life testing of 8-cm mercury ion thruster cathodes
[NASA-TM-X-73526] N77-11102

CATS
Predictive model of the auditory process as related to communication systems
[AD-A024300] N77-11656

CAUCHY PROBLEM
Compact transitive isometry groups
N77-11802

CAVITIES
Local temperatures in semigray nondiffuse cones and V-grooves
N77-11341
Density measurement of copper shaped charge jet using the flash radiography — using equivalence of optical density and thickness in X ray absorption
[ISL-R-101/76] N77-11376
Nonlinear analyses of the stress field near a crack or hole in a plate
N77-11430

CAVITY RESONATORS
Second harmonic generation in a bounded magnetoplasma
N77-11860

CDC COMPUTERS
An hierarchic multi-suppliers computer network of a research laboratory with two settlements — real time operation
[NLR-MP-75012-U] N77-11746

CDC 6600 COMPUTER
Critical equipment list information retrieval
[AD-A025070] N77-11701

CELESTIAL GEODESY
Star catalogues and their significance to geodesy of the 1980's
[AD-A024156] N77-11938

CEMENTATION
Chemically reacting flows in porous media
N77-11327

CENSUS
The census and transportation planning: Survey of evaluations and recommendations as to the usefulness of the 1970 census data in urban transportation planning
[PB-254802/2] N77-11924

CENTRAL ATLANTIC REGION [US]
Identification and analysis of mid-Atlantic onshore OCS impact
[PB-254925/1] N77-11516

CENTRAL PROCESSING UNITS
Programmable data collection platform study
[NASA-CR-144819] N77-11086

CENTROIDS
Centroid and moments of an area using a digitizer
[NASA-TM-X-73528] N77-11718

CERAMICS
Study of erosion mechanisms of engineering ceramics
[AD-A025258] N77-11184
A new ceramic flat pack for quartz resonators
[AD-A024074] N77-11310
Ceramic materials and components for small automotive gas turbine engine
[AD-A025472] N77-11417

CHALCOGENIDES
Nonlinear optical properties and crystal growth of II-IV-V2 chalcopyrite semiconductors
N77-11870

CHAPMAN-ENSKOG THEORY
Theory of shock structure in a Maxwell gas based on the Chapman-Enskog development through Super-Super-Burnett order
N77-11324

CHARACTER RECOGNITION
OCR and its application to documentation: A state of the art review
[AGARD-AG-216] N77-11907

CHARGE CARRIERS
Techniques for modeling multidimensional effects in integrated devices
N77-11292

CHARGE COUPLED DEVICES
Charge coupled scanned IR imaging sensors
[AD-A025224] N77-11858

CHARGE DISTRIBUTION
Charge and current distributions on, and input impedance of moderately fat transmitting crossed-monopole antennas
[AD-A025429] N77-11283

CHARGED PARTICLES
Escape of charged particles from a neutron star
N77-11934

CHARPY IMPACT TEST
Effect of fiber diameter and matrix alloys on impact-resistant boron/aluminum composites
[NASA-TN-D-8204] N77-11118

CHEMICAL ANALYSIS
Theoretical, numerical, and physical techniques for characterizing power plant plumes
[PB-253099/6] N77-11599
Sulfur dioxide interference in the measurement of ambient particulate sulfates, volume 2
[PB-254427/8] N77-11607
ASTP chemical and microbiological analysis of potable water
[NASA-TM-X-58192] N77-11675

CHEMICAL BONDS
Aqueous artefacts: The riddle of bound water
[AD-A024643] N77-11663

CHEMICAL LASERS
Experimental studies of a continuous-wave HF[DF] confocal unstable resonator
[AD-A025268] N77-11395

CHEMICAL PROPERTIES
Structure-property relationships bibenzoxazole polymers containing fluorocarbon linkages
[AD-A023822] N77-11180
Determining the shelflife of solid propellants
N77-11194

CHEMICAL REACTIONS
Absolute rate of the reaction of C I[2P] with methane from 200-500 K
[NASA-TM-X-71221] N77-11136
Development of high pressure devices and high pressure syntheses
[BMFT-FB-76-19] N77-11177
A hydrodynamic stability analysis of some proposed model equations for biofluids
N77-11322

CHEMISORPTION
Improved microwave-discharge source for UV photoemission
[PB-255204/0] N77-11382

CHLORINE
Absolute rate of the reaction of C I[2P] with methane from 200-500 K
[NASA-TM-X-71221] N77-11136
Comment on A paradox: The thermal rate coefficient for the H + DCl yields HCl + D exchange reaction
[AD-A023896] N77-11139

CHLORINE COMPOUNDS
Preliminary report on electron energy-loss measurements for CClF3, CCl2F2, and CCl3F
[PB-255227/1] N77-11630

CHLOROPHYLLS
Spectral reflectance signatures of coastal pollutants — Delaware
[E77-10011] N77-11486

CHOROID MEMBRANES
Safe use of the P-3 strobe lamp
[AD-A024036] N77-11658

CHROMIUM
Properties of Cr-SiO2-n Si tunnel diodes
N77-11291
Electron impact ionization cross sections of gold, chromium and iron
[AD-A024208] N77-11834

CHROMIUM ALLOYS
Hot hardness of nickel-rich nickel-chromium-aluminum alloys
[NASA-TM-X-3429] N77-11155
Ellipsometric spectroscopic study of breakdown of Fe-Cr and Fe-Cr-Mo alloys
[PB-255203/2] N77-11170
Electrical transport properties of itinerant and localized electron magnetic systems
N77-11878

CHROMIUM STEELS
Electron-microscopical studies of passive films on stainless steels
[PB-255190/1] N77-11168

CHRONOPHOTOGRAPHY
Some properties of sources used in hypervelocity holography — coherent light sources
[ISL-CO-217/75] N77-11369

CIRCUIT BREAKERS
An HVDC breaker with sequential switching
N77-11286

CIRCUIT DIAGRAMS
Analysis and design of relational schemata for database systems
N77-11690

CIRCUITS
Development of electronic circuits for advanced high temperature fire detectors
[AD-A023843] N77-11318

CIRCULAR CYLINDERS
Added mass and damping forces on circular cylinders
[AD-A024037] N77-11353

CIRCULAR PLATES
Three-dimensional finite element analysis of a large circular disc with circular penetrations
[WAPD-TM-1206] N77-11444

CITIES
Assessing the relationship between urban form and travel requirements: A literature review and conceptual framework
[PB-254988/9] N77-11923
Transportation planning for small urban areas
[PB-256119/9] N77-11932
Economic welfare impacts of urban noise
[PB-256411/0] N77-11933

CIVIL AVIATION
Toward new heights — air transportation in the Soviet Union
[NASA-TT-F-17248] N77-11019

CLEANING
Surface cleaning by glow discharge in high volume gas flow
[AD-A024225] N77-11219

CLINICAL MEDICINE
Changes in clinical cardiologic measurements associated with high +G sub z stress
N77-11645

CLOSURE LAW
On the nature of the closure phenomena and its effect on fatigue crack growth rate
N77-11431

CLOUD SEEDING
Ecological impacts of snowpack augmentation in the San Juan Mountains of Colorado
[PB-255012/7] N77-11514

COAL
Methanol from coal fuel and other applications
[ORAU-126] N77-11200
Applying computer-drawn maps of geologic data to analysis of mining problems
[PB-255497/0] N77-11518
The air quality and economic implications of supplementary control systems in Illinois — considering electric power plant fuels
[PB-255699/1] N77-11588
Design, development, fabrication and testing of a portable self-contained respirable dust mass monitor
[PB-254503/6] N77-11681

COAL GASIFICATION
Basic studies of coal pyrolysis and hydrogasification
[PB-254878/2] N77-11511
Problems and solutions in the use of coal analyses
[FE-0390-1] N77-11535
The use of an interactive energy model for technology assessment with special reference to underground coal gasification
[PB-255543/1] N77-11545
Draft environmental assessment of application by ERDA for a special land use permit for use of public lands in Wyoming for in situ coal gasification experiments
[UCID-17011] N77-11572

Environmental impact studies related to underground coal gasification
[TID-27003] N77-11573
Field test sampling/analytical strategies and implementation cost estimates: Coal gasification and flue gas desulfurization
[PB-254166/2] N77-11581
COAL LIQUEFACTION
Basic studies of coal pyrolysis and hydrogasification
[PB-254878/2] N77-11511
Problems and solutions in the use of coal analyses
[FE-0390-1] N77-11535
COASTS
Spectral reflectance signatures of coastal pollutants — Delaware
[E77-10011] N77-11486
Use of LANDSAT data for natural resources investigation in the lower basin of Danube and Danube Delta — Romania
[E77-10032] N77-11494
LANDSAT menhaden and thread herring resources investigation, Gulf of Mexico
[E77-10036] N77-11497
COAXIAL PLASMA ACCELERATORS
Velocity limitations in coaxial plasma gun experiments with gas mixtures
[TRITA-EPP-76-02] N77-11865
COBALT ALLOYS
Hot corrosion of cobalt-base alloys
[AD-A024425] N77-11160
Directionally solidified in situ metal matrix composites, part 1 — superalloys for manufacture of turbine blades
[AD-A024217] N77-11162
Development of directionally solidified eutectic nickel and cobalt alloys — for turbine blades
[AD-A024420] N77-11165
COBALT COMPOUNDS
Magnetoelastic interactions in SmCo5
N77-11810
COCKPITS
Influence of aircraft angle of attack on high G cockpit design
[AD-A025083] N77-11043
Rationale and description of a coordinated cockpit display for aircraft flight management
[NASA-TM-X-3457] N77-11044
CODING
Optimal linear coding for a multichannel system
N77-11251
Computational algorithms for coding bound exponents
N77-11715
COHERENCE COEFFICIENT
Core noise source diagnostics on a turbofan engine using correlation and coherence techniques
[NASA-TM-X-73535] N77-11053
COHERENT LIGHT
Some properties of sources used in hypervelocity holography — coherent light sources
[ISL-CO-217/75] N77-11369
COHERENT SCATTERING
Local measurement and proportional density of gaseous flow by Raman anti-Stokes coherent scattering
N77-11235
COLD CATHODE TUBES
Repetitively pulsed cold cathode studies
[AD-A024354] N77-11317
COLD CATHODES
Technological studies of high mission current density cathodes
[BMFT-FB-T-76-10] N77-11301
COLD WELDING
Surface cleaning by glow discharge in high volume gas flow
[AD-A024225] N77-11219
COLLISION AVOIDANCE
The establishment of safe separations between aircraft in flight
[NLR-MP-75041-U] N77-11020
COLLOIDS
The International Conference on Colloid and Surface Science [IUPAC]
[AD-A024159] N77-11142
COLOR
Sources of organic color in natural waters
N77-11484
COLOR PHOTOGRAPHY
Polychromatic light holography
[ISL-R-124/75] N77-11372
COLUMNS [PROCESS ENGINEERING]
Computer control of distillation column containing analog overrides
N77-11703
COMBAT
Report of the Army Scientific Advisory Panel Ad Hoc Group on fire-safe fuels
[AD-A023763] N77-11208
The pathophysiology of high sustained +G sub z acceleration, limitation to air combat manoeuvering and the use of centrifuges in performance training
[AGARD-CP-189] N77-11644
The use of a fixed base simulator as a training device for high sustained or ACM [Air Combat Maneuvering] +G sub z stress
N77-11652
Stress response and stress tolerance in fighter pilots during 6 G manoeuvers
N77-11653
COMBINATORIAL ANALYSIS
An algorithm for synthesis of combinational logic using decomposition and probability
N77-11706
COMBUSTION
Project SQUID: A cooperative program of fundamental research related to jet propulsion
[AD-A024004] N77-11059
COMBUSTION CHAMBERS
Performance and emission characteristics of swirl-can combustors to near-stoichiometric fuel-air ratio
[NASA-TN-D-8342] N77-11056
Sputtering phenomena of discharge chamber components in a 30-cm diameter Hg ion thruster
[NASA-TM-X-73533] N77-11104
Reduction of gaseous pollutant emissions from gas turbine combustors using hydrogen-enriched jet fuel
[NASA-CR-149146] N77-11198
On the convection limited self-sustained acoustic vibrations in a closed cylindrical chamber
N77-11359
COMBUSTION CONTROL
Nitramine propellant research
[NASA-CR-149148] N77-11199
COMBUSTION PRODUCTS
Development of a Raman system as a combustion diagnostic tool
[AD-A023935] N77-11140
Total suspended particulates: Review and analysis
[PB-255858/3] N77-11574
Evaluation of Rexnord gravel bed filter
[PB-255095/2] N77-11597
COMBUSTION STABILITY
Analytical prediction of motor component vibrations driven by acoustic combustion instability
[AD-A025261] N77-11109
COMET HEADS
Occurence of gas hydrates in the nucleii of comets
[NASA-TT-F-16740] N77-11937
COMETS
A comparison of the composition of new and evolved comets
[NASA-TM-X-71215] N77-11945
COMFORT
User evaluation of ride technology research
[NASA-CR-2746] N77-11667
COMMAND AND CONTROL
DAISY: An applications perspective
[AD-A023875] N77-11904
COMMERCIAL AIRCRAFT
High speed computer studies of vortex motions in relation to aircraft wake turbulence
[AD-A024290] N77-11013
COMMUNICATION CABLES
Analysis of economics of a TV broadcasting satellite for additional nationwide TV programs
[BMFT-FB-T-76-05] N77-11270
The systematic design of communications line control procedures
N77-11744
COMMUNICATION EQUIPMENT
Predictive model of the auditory process as related to communication systems
[AD-A024300] N77-11656
COMMUNICATION SATELLITES
Cost-benefit analysis of space technology
[NASA-TM-X-3453] N77-11908
COMMUNICATION THEORY
A study of the remote neighborhood office center concept
[NASA-CR-149190] N77-11892
COMMUNICATIONS TECHNOLOGY SATELLITE
Test program for transmitter experiment package and heat pipe system for the communications technology satellite
[NASA-TM-X-3455] N77-11268
Description and expected performance of flight-model, 12-gigahertz, output stage tube for the communications technology satellite
[NASA-TM-X-3441] N77-11295
COMPACTING
Influence of mica on the compaction and bearing properties of base course aggregate
[VTI-55] N77-11920
COMPARATOR CIRCUITS
Window comparator
[NASA-CASE-FRC-10090-1] N77-11296
COMPATIBILITY
Propellant material compatibility program and results
[NASA-CR-149149] N77-11197
COMPILERS
A verification system for JOVIAL/J3 programs [Rugged Programming Environment: RPE/1]
[AD-A024395] N77-11730
COMPONENTS
Spherical bearing
[NASA-CASE-MFS-23447-1] N77-11403
COMPOSITE MATERIALS
Program for establishing long-time flight service performance of composite materials in the center wing structure of C-130 aircraft. Phase 4: Ground/flight acceptance tests
[NASA-CR-145043] N77-11032
Development of a graphite horizontal stabilizer
[AD-A023767] N77-11036
High temperature thermocouple system for advanced aircraft turbine engines
[AD-A025500] N77-11062
Nonlinear analysis of laminated fibrous composites
N77-11113
Compressive test method for fiber reinforced composites
[FOK-R-1877] N77-11123
The effects of moisture on the mechanical performance of T300/graphite/glass/epoxy hybrid composites
[AD-A023668] N77-11124
Simple thickness modes and shear correction coefficients for viscoelastic Timoshenko beams
[AD-A023771] N77-11125
Mechanical properties of glass and Kevlar molded composites
[AD-A024196] N77-11126
Investigation of stress levels causing significant damage in composites
[AD-A024537] N77-11127
Preparation and properties of beta-alumina/glass composites
[PB-255549/8] N77-11130
A composite transer matrix-synthesis approach to piping dynamic analysis
N77-11334
Rim-spoke composite flywheels: Stress and vibration analysis
[NASA-TN-D-8339] N77-11442
Development of a computer program for the dynamic nonlinear response of reinforced concrete slabs under blast loading
[AD-A024050] N77-11458
Development and fabrication of an advanced liquid cooling garment
[NASA-CR-137974] N77-11673
COMPOSITE PROPELLANTS
High energy composite double base solid propellants
N77-11189
New propellants for tactical weapons: Silanes
N77-11190
Strong impact propellants of little specific attenuation for radioelectric waves
N77-11191
COMPOSITION [PROPERTY]
A comparison of the composition of new and evolved comets
[NASA-TM-X-71215] N77-11945
COMPRESSIBLE FLOW
Mach 4 free-jet tunnel starting experiments for a hypersonic research engine model causing high blockage
[NASA-TM-X-3418] N77-11069
COMPRESSION TESTS
Compressive test method for fiber reinforced composites
[FOK-R-1877] N77-11123
Structural performance of masonry walls under compression and flexure
[PB-255075/4] N77-11459
COMPRESSIVE STRENGTH
Compressive test method for fiber reinforced composites
[FOK-R-1877] N77-11123
COMPRESSOR BLADES
Compressor blade setting angle accuracy study, volume I
[NASA-CR-135068-VOL-1] N77-11046
Compressor blade setting angle accuracy study. Volume 2: Data compilation
[NASA-CR-135068-VOL-2] N77-11047
COMPRESSOR ROTORS
The rotating stator concept. Experimental performance characteristics compared with the conventional compressor
[AD-A024465] N77-11411
COMPRESSORS
Secondary flow in axisymmetric compressors
[NASA-TT-F-15497] N77-11009
COMPUTATION
Calculation of the longitudinal aerodynamic characteristics of wing-flap configurations with externally blown flaps
[NASA-CR-2705] N77-11006
COMPUTER ASSISTED INSTRUCTION
Adaptive computer-assisted tutorials: A cybernetic approach optimization with finite-state machines
[AD-A024252] N77-11758
Partially observable Markov decision processes over an infinite planning horizon with discounting
[AD-A025077] N77-11778
COMPUTER GRAPHICS
Developmental system for microcomputer based intelligent graphics terminals
[LA-UR-76-125] N77-11694

Computer graphics applications in transportation information systems
[PB-254795/8] N77-11696
Graphics system modeling: Verification and applications
[AD-A024068] N77-11699
TEKPACK: A utility package for the Tektronix 4012 graphics terminal and the Univac 1830A digital computer
[AD-A025505] N77-11702
Computer program for converting visual display from DEC, GT-44 to Stromberg datagraphi X4020
[AD-A025081] N77-11736
An operating manual for computer storage, access and presentation of plant trial data
[PB-256058/9] N77-11737
Experiments in texture perception
[AD-A024975] N77-11855

COMPUTER INFORMATION SECURITY
STIL: A static tool implementation language
[UCID-17014] N77-11722
Research on a high level language approach to operating system design
[AD-A023866] N77-11733

COMPUTER PROGRAMMING
An ALGOL program for the calculation of incompressible three dimensional turbulent boundary layers
[NLR-TR-74159-U] N77-11010
Computational results of the NISLAP and AIM-LASER programs for satellite position predictions --- noting program accuracy and perturbing forces
[VTH-212] N77-11080
Description of the universal program for calculating the navigational information on the location of an artificial earth satellite
[NASA-TT-F-17273] N77-11093
ROM programmable cellular array
N77-11289
Data structures: Specification and realization
[AD-A024396] N77-11698
Critical equipment list information retrieval
[AD-A025070] N77-11701
Large-scale programming in Markov decision processes
N77-11712
Some data-base applications of constraint expressions
[AD-A024149] N77-11727
Research on automatic programming
[AD-A024335] N77-11728
A verification system for JOVIAL/J3 programs [Rugged Programming Environment: RPE/1]
[AD-A024395] N77-11730
The class concept in the SIMULA programming language
[PB-256045/6] N77-11738
Utility programs for the UNIVAC 9300 system at the MCL computer facility
[PB-255891/4] N77-11739
Associative processing of network flow problems
[AD-A024380] N77-11750
Dynamics of inertia variant machinery
N77-11809
Advanced dial-a-ride algorithms research project
[PB-254752/9] N77-11922

COMPUTER PROGRAMS
A FORTRAN program for the computation of two-dimensional or axisymmetric nozzles --- applied to supersonic free jets
[ISL-R-110/75] N77-11012
Preliminary sizing and performance evaluation of supersonic cruise aircraft
[NASA-TM-X-73936] N77-11031
V/STOL aircraft noise prediction [jet propulsors] --- computer program
[AD-A028765/6] N77-11045
Navigation input to level C OFT navigation functional subsystem software requirements [rendezvous onorbit-2]
[NASA-CR-151007] N77-11077
Electrical characteristics for rectangular conductors --- using four computer programs
[SAND-75-0626] N77-11297
Computer analysis of the performance of a swing-pad bearing with a compliant pad surface
[AD-A024418] N77-11414
Development of a computer program for the dynamic nonlinear response of reinforced concrete slabs under blast loading
[AD-A024050] N77-11458
APES: Second generation two-dimensional fracture mechanics and stress analysis by finite elements
[AD-A025217] N77-11474
Digital image processing
[E77-10035] N77-11496
Computer program projecting fictitious longitude and latitude systems onto standard Mercator grids
[AD-A025076] N77-11517
AS-11B-X automated stereomapper
[AD-A025428] N77-11524
Feasibility investigation of the Giromill for generation of electrical power --- computer programs
[COO-2617-75/1] N77-11536
Environmental impact computer system attribute descriptor package: Reference document
[AD-A024303] N77-11582
Graphics system modeling: Verification and applications
[AD-A024068] N77-11699
TEKPACK: A utility package for the Tektronix 4012 graphics terminal and the Univac 1830A digital computer
[AD-A025505] N77-11702
The use of dynamic assertions to improve software quality
N77-11710
MATCH package for the ANL three-view geometry program
[ANL/HEP/PR-76-11] N77-11719
ADINDEX: A PL/1 program that produces simple or structured indexes from ADSEP data bases
[ORNL-CSD-TM-1] N77-11720
The multivariable identification package for a PDP-11 computer: User guide
[OUEL-1142/76] N77-11725
A computer program to simulate scenario functions
[AD-A024484] N77-11729
Antenna prediction computer problems
[AD-A024552] N77-11734
Computer program for converting visual display from DEC, GT-44 to Stromberg datagraphi X4020
[AD-A025081] N77-11736
A FORTRAN computer program for calculating the linear prolate functions
[AD-A025210] N77-11742
Man, design, machine: An inquiry into principles of normative planning for computer-based technical systems illustrated by a case design of an entry, storage and retrieval system for scientific communication and technology tranfer
N77-11743
Measurement of computer communication networks
[PB-255618/1] N77-11747
Knowledge acquisition from structural descriptions
[AD-A025074] N77-11759
Explicit inverses of some special matrices [with a few computer programs]
[ORNL-CSD-2] N77-11765

COMPUTER STORAGE DEVICES
ROM programmable cellular array
N77-11289
Analysis and design of relational schemata for database systems
N77-11690
System design of functional memory based processors
N77-11691
An efficient implementation of monitors and condition variables
[AD-A023931] N77-11697
An optimal algorithm for testing random access memories
[AD-A023894] N77-11732
An operating manual for computer storage, access and presentation of plant trial data
[PB-256058/9] N77-11737

COMPUTER SYSTEMS DESIGN
A systematic approach to operational scheduling for information collection systems
N77-11483
Analysis and design of relational schemata for database systems
N77-11690
System design of functional memory based processors
N77-11691
Some results in majority decoding of binary cyclic codes
N77-11711
The systematic design of communications line control procedures
N77-11744

COMPUTER SYSTEMS PROGRAMS
Compressor blade setting angle accuracy study. Volume 2: Data compilation
[NASA-CR-135068-VOL-2] N77-11047
Effects of modifications to the space shuttle entry guidance and control systems
[NASA-TN-D-8273] N77-11087
Automatic program testing
N77-11716
STIL: A static tool implementation language
[UCID-17014] N77-11722
TREND: A program using cumulative sum methods to detect long-term trends in data
[AECL-5262] N77-11723

COMPUTER TECHNIQUES
Applying computer-drawn maps of geologic data to analysis of mining problems
[PB-255497/0] N77-11518
Continuing research in the development of interactive man-computer systems for engineering-construction projects
[PB-252927/9] N77-11679

COMPUTERIZED DESIGN
Computer-aided design and manufacturing for extrusion of aluminum, titanium, and steel structural parts [phase 1]
[AD-A023946] N77-11171

COMPUTERIZED SIMULATION
High speed computer studies of vortex motions in relation to aircraft wake turbulence
[AD-A024290] N77-11013
Simulation of automatic detection and track-while-scan systems for unstabilized shipboard radars
N77-11257
A model for predicting integrated man-machine system reliability. 2: Model validation
[AD-A023886] N77-11420
The use of an interactive energy model for technology assessment with special reference to underground coal gasification
[PB-255543/1] N77-11545
Commercial building unitary heat pump system with solar heating
[PB-255488/9] N77-11551
Earth and ocean modeling
[NASA-CR-150055] N77-11617
SAINT II documentation manual
[AD-A024286] N77-11689
A computer program to simulate scenario functions
[AD-A024484] N77-11729
Sequential partition detectors with applications
N77-11781
The influence of data order on the Lieberman-Ross method
[AD-A024518] N77-11792

CONCENTRATORS
Attic concentrator type solar energy collector
[BNL-50493] N77-11539

CONCRETES
Cracking in concrete: Attributed to defects in construction
[PB-252920/4] N77-11451
Comparison of 4-1/2- and 7-in. [6-in. nominal] maximum size aggregate mixtures for new lock and dam no. 26, Mississippi River
[AD-A023968] N77-11455
Concrete aggregate durability tests
[PB-255436/8] N77-11457
Development of a computer program for the dynamic nonlinear response of reinforced concrete slabs under blast loading
[AD-A024050] N77-11458
Highway insulating material evaluation
[PB-254792/5] N77-11466
Polymer pavement concrete for Arizona study 2
[PB-255692/6] N77-11470
Analysis of reinforced concrete beams subjected to fire
[PB-256425/0] N77-11471
Accelerated test development for Portland cement concrete
[PB-255714/8] N77-11472
Bond characteristics of model reinforcement
[PB-255847/6] N77-11473
The influences of retarding admixtures on volume changes of concrete
[PB-254929/3] N77-11477

CONDUCTION ELECTRONS
Quantum size oscillations and size effects
N77-11877

CONES
Diffraction by wedges and cones
N77-11848

CONFERENCES
Conference on the Development of Fire-Resistant Aircraft Passenger Seats
[NASA-TM-X-73144] N77-11111
The International Conference on Colloid and Surface Science [IUPAC]
[AD-A024159] N77-11142
Small solid propellant rockets for field use
[AGARD-CP-194] N77-11185
Regional seminar on a system of standardization and metrology for Latin America
[PB-254469/0] N77-11214
Applications of non-intrusive instrumentation in fluid flow research --- including Raman spectra, Laser Doppler Velocimeters, and electron beams; conference proceedings
[AGARD-CP-193] N77-11221
Fluid Dynamics Panel Symposium on Flow Separation
[AGARD-AR-98] N77-11357
Meeting report: Advanced fossil fuels sector group
[PB-255117/4] N77-11549
Societal implications of energy scarcity. Social and technological priorities in steady state and constricting systems
[PB-253097/0] N77-11556
Energy conservation through effective energy utilization: 1973 Engineering Foundation Conference
[PB-255878/1] N77-11560
Proceedings of the Workshop on Modeling the Interrelationships between the Energy Sector and the General Economy
[PB-255696/7] N77-11561

Conference report: Energy Conservation in Transportation and Construction
[PB-255857/5] N77-11562
Research to anticipate environmental impacts of changing resource usage
[PB-256293/2] N77-11602
Geomagnetic effects: A rapporteur paper
[AD-A023720] N77-11620
Dynamic programming approach to estimating gaps in large economic data bases
[LBL-4271] N77-11909

CONFIDENCE LIMITS
A note on distribution-free tolerance limits
[AD-A024137] N77-11788

CONFIGURATION MANAGEMENT
Conceptual designs for a modular remotely piloted vehicle
[AD-A023844] N77-11035

CONGRESSIONAL REPORTS
Crew training and support activities
[GPO-75-984] N77-11678
Noise Control Act extension
[GPO-52-021] N77-11910

CONICAL BODIES
Prediction of the drag coefficient of a 20-degree conical ribbon parachute
[NASA-CR-150056] N77-11003
Local temperatures in semigray nondiffuse cones and V-grooves
N77-11341

CONSTRUCTION
Cracking in concrete: Attributed to defects in construction
[PB-252920/4] N77-11451
Energy use in the contract construction industry
[PB-245422/1] N77-11557
Energy use in the contract construction industry. Appendix A: Study methodology
[PB-245423/9] N77-11558
Energy use in the contract construction industry. Appendix B: Assessment of construction equipment availability, energy requirements, and construction industry capacity to support Project Independence
[PB-245424/7] N77-11559
Continuing research in the development of interactive man-computer systems for engineering-construction projects
[PB-252927/9] N77-11679

CONSTRUCTION MATERIALS
Design and construction of airport pavements on expansive soils
[AD-A028094/1] N77-11437
Comparison of 4-1/2- and 7-in. [6-in. nominal] maximum size aggregate mixtures for new lock and dam no. 26, Mississippi River
[AD-A023968] N77-11455
Technology for using sulfate waste in highway construction
[PB-254815/4] N77-11468
Optimizing the use of materials and energy in transportation construction
[PB-253713/2] N77-11475

CONTACT POTENTIALS
Isothermal elastohydrodynamic lubrication of point contacts. III: Fully flooded results
[NASA-TN-D-8317] N77-11400

CONTACT RESISTANCE
Conformal and non-Hertzian contact problems
N77-11811

CONTAMINANTS
Pollutant formation and multiple stationary states in radiantly stabilized flames
N77-11133
MIUS systems analysis: Effects of unfavorable meteorological conditions and building configurations on air quality
[ONRL/HUD/MIUS-29-ADD-2] N77-11571
Analysis of the data from the three-dimensional gradient study — for atmospheric pollutant layers diffusion
[PB-253936/9] N77-11578
Technical manual for measurement of fugitive emissions: Upwind/downwind sampling method for industrial emissions
[PB-253092/1] N77-11585

CONTINENTAL SHELVES
Economic limits of OCS production wells
[PB-255320/4] N77-11515
Identification and analysis of mid-Atlantic onshore OCS impact
[PB-254925/1] N77-11516

CONTINUOUS WAVE LASERS
Experimental studies of a continuous-wave HF[DF] confocal unstable resonator
[AD-A025268] N77-11395

CONTOURS
Calculation of multi-contour thin-walled structures by the method of sections
[NASA-TT-F-17284] N77-11029

CONTRACTS
A conceptual model for evaluating contractor management during source selection
[AD-A023817] N77-11896

CONTROL SIMULATION
Control by model error estimation
[NASA-CR-150059] N77-11755

CONTROL THEORY
Stochastic multistage linear differential game with decision-time constraints
N77-11784
Design of stochastic linear control systems according to cumulant based performance criteria
[AD-A025078] N77-11795

CONTROLLERS
Vibration of a flexible spacecraft with momentum exchange controllers
N77-11095

CONVECTIVE FLOW
Hydrodynamic aspects of the critical heat flux in subcooled convection boiling
N77-11329

CONVECTIVE HEAT TRANSFER
A study of internal forced convective boiling heat transfer for binary mixtures
N77-11332
On the convection limited self-sustained acoustic vibrations in a closed cylindrical chamber
N77-11359

CONVEXITY
Critical cutsets of graphs and canonical facets of set packing polytopes
[AD-A023854] N77-11806

CORONARY CIRCULATION
Coronary flow and myocardial biochemical responses to high sustained +G sub z acceleration
N77-11649

CORROSION
Hot corrosion of cobalt-base alloys
[AD-A024425] N77-11160
Electron-microscopical studies of passive films on stainless steels
[PB-255190/1] N77-11168
Chemical breakdown of passivity
[PB-255102/4] N77-11169
Ellipsometric spectroscopic study of breakdown of Fe-Cr and Fe-Cr-Mo alloys
[PB-255203/2] N77-11170

CORROSION RESISTANCE
Corrosion behaviour of mixed laminates [CFRP core with both 7075-T6 clad and 5052-H38 faces]
[FOK-R-1868] N77-11121
Refinement of promising coating compositions for directionally cast eutectics
[NASA-CR-135103] N77-11154

COSMIC RAYS
Geomagnetic effects: A rapporteur paper
[AD-A023720] N77-11620
Three-dimensional structure of the extended solar magnetic field and the sunspot cycle variation in cosmic ray intensity
[NASA-CR-149174] N77-11956
Determination of cosmic ray muon intensities deep underground
N77-11960
The mass spectrum of charged cosmic rays at mountain altitudes
N77-11962
A limit on the inhomogeneity of the cosmic microwave background radiation at an angular scale of 1.25 arcmin
N77-11964
The relationship between the galactic matter distribution, cosmic ray dynamics, and gamma ray production
[NASA-TM-X-71224] N77-11965
A quasi-linear kinetic equation for cosmic rays in the interplanetary medium
[AD-A023849] N77-11966

COSMOLOGY
Space station systems analysis study. Part 1, volume 1: Executive study
[NASA-CR-151102] N77-11084
Space station systems analysis study. Part 1, volume 2: Technical report
[NASA-CR-151103] N77-11085
Homogeneous cosmologies with strong neutrino fields
N77-11844

COST ANALYSIS
Economic limits of OCS production wells
[PB-255320/4] N77-11515
Field test sampling/analytical strategies and implementation cost estimates: Coal gasification and flue gas desulfurization
[PB-254166/2] N77-11581
Measurement of computer communication networks
[PB-255618/1] N77-11747
Cost-benefit analysis of space technology
[NASA-TM-X-3453] N77-11908
The consequences of transit fare and service policies: A classified bibliography
[PB-253101/0] N77-11931

COST EFFECTIVENESS
Solid Polymer Electrolyte [SPE] fuel cell technology, program review, phase 2
[NASA-CR-150957] N77-11532
Attic concentrator type solar energy collector
[BNL-50493] N77-11539
Economic impact study of the proposed motor vehicle [in-use] noise regulations
[PB-255686/8] N77-11583

COST ESTIMATES
Use of synthetic benchmarks for estimating service bureau processing charges
[PB-255054/9] N77-11726

COST REDUCTION
Programmable data collection platform study
[NASA-CR-144819] N77-11086

COUPLED MODES
Radio-frequency wave coupling and mode conversion at the lower hybrid resonance
N77-11249
Radiation and coupling properties of straight and curved optical waveguides
N77-11851

COVARIANCE
The covariance of temperature and ozone due to planetary-wave forcing
[NASA-TM-X-71212] N77-11613
Covariance-invariant discrete-time systems
[AD-A024273] N77-11757

CRACK INITIATION
Crack growth data of 2024-T3-clad as determined in Fokker report R-1764 and in NLR report TN-M2092 — noting crack growth rates in specimens tested in fatigue
[FOK-R-1814] N77-11120

CRACK PROPAGATION
Analog computation assessment of the risk of structural failure due to crack growth under random loading
[AD-A025266] N77-11042
Effect of microstructure on the fatigue crack growth of a powder metallurgy nickel-base superalloy
N77-11153
Development of high fracture toughness in maraging steels
[AD-A025096] N77-11172
On the nature of the closure phenomena and its effect on fatigue crack growth rate
N77-11431
Characterization of fatigue cracks with ultrasonics
N77-11432
Current practice on estimating crack growth damage accumulation with specific application to structural safety durability and reliability
[AD-A025499] N77-11478

CRACKING [FRACTURING]
Cracking in concrete: Attributed to defects in construction
[PB-252920/4] N77-11451
Thermal activity of base course material related to pavement cracking
[PB-254754/5] N77-11476

CRACKS
Fracture toughness of 8mm 2024-T3 non clad plate with long central cracks
[FOK-R-1879] N77-11449

CREEP ANALYSIS
Cyclic structural analysis of air-cooled gas turbine blades and vanes
[NASA-TM-X-73494] N77-11439

CRITERIA
Designing a river basin sampling system
[PB-255022/6] N77-11593

CRITICAL FREQUENCIES
Numerical representation of monthly median critical frequencies of the regular E region [foE]
[PB-255484/8] N77-11276

CRITICAL MASS
Investigation of critical phenomena in nickel through perturbed angular correlation experiments
N77-11147

CRITICAL POINT
Critical points in magnetic systems, a neutron diffraction study of CsCoCl32D2O
[RCN-235] N77-11885

CRUDE OIL
The production and refining of crude oil into military fuels
[AD-A024652] N77-11207
Mandatory Canadian crude oil allocation regulations
[PB-255319/6] N77-11509
Economic limits of OCS production wells
[PB-255320/4] N77-11515
User's guide to petroleum industry survey data type
[PB-256635/4] N77-11544

CRYOGENIC EQUIPMENT
Study of a Vuilleumier cycle cryogenic refrigerator for detector cooling on the limb scanning infrared radiometer
[NASA-CR-145078] N77-11211
Low temperature heat exchangers
[BMFT-FB-T-76-07] N77-11350

CRYOGENIC FLUID STORAGE
Experimental and analytical study of thermal acoustic oscillations — in the transfer and storage of cryogens
[NASA-CR-150051] N77-11212

CRYOGENIC FLUIDS
Vocabulary of aerospace safety terms pertaining to cryogenic safety, fires, explosions, and structure failure
[NASA-TM-X-73521] N77-11901
CRYOGENIC MAGNETS
Design study of steady-state 30-tesla liquid-neon-cooled magnet
[NASA-TN-D-8337] N77-11213
CRYSTAL DISLOCATIONS
The epitaxial growth of thin films and the interfacial dislocations studied by RHEED and transmission electron microscopy
N77-11868
CRYSTAL GROWTH
Nonlinear optical properties and crystal growth of II-IV-V2 chalcopyrite semiconductors
N77-11870
CRYSTAL STRUCTURE
Inelastic neutron scattering in solid neon at high pressure
N77-11829
One-electron energy bands of silicon dioxide in the ideal beta cristobalite structure
N77-11882
On the angular divergence of out-going beams in an asymmetric diffraction geometry
[PB-255865/8] N77-11886
CURING
The initiator-activator relationship in the cold-cured polymerization of methylmethacrylate
[AD-A023678] N77-11179
CURRENT DENSITY
Technological studies of high mission current density cathodes
[BMFT-FB-T-76-10] N77-11301
CURRENT DISTRIBUTION
Charge and current distributions on, and input impedance of moderately fat transmitting crossed-monopole antennas
[AD-A025429] N77-11283
Radiation from a current filament driven by a traveling wave
[NASA-TN-D-8302] N77-11294
CURRENT REGULATORS
Discrete modeling and analysis of switching regulators
N77-11287
CURVE FITTING
Revised aircraft load curves and vehicle ice-thickness tables for annual ice sheet operations near McMurdo, Antarctica
[AD-A024051] N77-11461
CYBERNETICS
Adaptive computer-assisted tutorials: A cybernetic approach optimization with finite-state machines
[AD-A024252] N77-11758
CYCLIC LOADS
Cyclic structural analysis of air-cooled gas turbine blades and vanes
[NASA-TM-X-73494] N77-11439
CYLINDRICAL BODIES
A new method for measuring the Newtonian gravitational constant, G
N77-11807
Scattering from large planar gratings of compliant cylindrical shells
[AD-A025279] N77-11820
CYLINDRICAL SHELLS
Nonstationary analysis of ohmic and viscous heating of a cylindrical plasma shell
[TRITA-EPP-75-19] N77-11864

D

DAMPING
Added mass and damping forces on circular cylinders
[AD-A024037] N77-11353
DAMS
Comparison of 4-1/2- and 7-in. [6-in. nominal] maximum size aggregate mixtures for new lock and dam no. 26, Mississippi River
[AD-A023968] N77-11455
DARK ADAPTATION
The effect of pre-adapting spectral stimuli on visual response
[AD-A024312] N77-11659
DATA ACQUISITION
Space station systems analysis study. Part 1, volume 1: Executive study
[NASA-CR-151102] N77-11084
Space station systems analysis study. Part 1, volume 2: Technical report
[NASA-CR-151103] N77-11085
The use of remote sensing devices for acquiring data for environmental management purposes. Report 2: Application of photographic remote sensors to an environmental management problem
[AD-A025616] N77-11519
A review of case studies of technological innovations in state and local services
[PB-252914/7] N77-11926
DATA BASES
User evaluation of ride technology research
[NASA-CR-2746] N77-11667
Data structures: Specification and realization
[AD-A024396] N77-11698
ADINDEX: A PL/1 program that produces simple or structured indexes from ADSEP data bases
[ORNL-CSD-TM-1] N77-11720
Some data-base applications of constraint expressions
[AD-A024149] N77-11727
Evaluation of the feasibility of an independent HSA data base relative to proposed HSA budgets and staffing
[PB-254920/2] N77-11903
Data storage decisions for large data bases
[AD-A023874] N77-11905
Dynamic programming approach to estimating gaps in large economic data bases
[LBL-4271] N77-11909
DATA COLLECTION PLATFORMS
Programmable data collection platform study
[NASA-CR-144819] N77-11086
DATA COMPRESSION
RM2: rms error comparisons
[NASA-CR-149150] N77-11717
DATA CORRELATION
Development of photon correlation anemometry for application to supersonic flows
N77-11231
Measurement of periodic flows using laser Doppler correlation techniques
N77-11232
DATA LINKS
Study of the use of Cefly Lancer wideband data link equipment for Guardrail 2A, 4, and 5.
[AD-A025089] N77-11280
DATA MANAGEMENT
Vocabulary of aerospace safety terms pertaining to cryogenic safety, fires, explosions, and structure failure
[NASA-TM-X-73521] N77-11901
DATA PROCESSING
Test and evaluation of the beacon processing subsystem of the Automated Radar Terminal Systems [ARTS III] all-digital tracking level system
[AD-A028514/8] N77-11025
Comparison of human information processing performance with DOT and stroke alphabetic characters
[AD-A024099] N77-11686
Analysis and design of relational schemata for database systems
N77-11690
TREND: A program using cumulative sum methods to detect long-term trends in data
[AECL-5262] N77-11723
Practical natural language processing. The REL system as prototype
[AD-A024313] N77-11731
The stabilization of bilinear systems and its application to the discrete model reference adaptive control
N77-11754
Information sciences: Information processing systems and techniques. Bibliography, Apr. 1958 - Nov. 1975
[AD-A024600] N77-11902
A photometric study of the Orion OB 1 association. 2: Photometric analysis
[NASA-TM-X-71217] N77-11936
DATA PROCESSING EQUIPMENT
Finite state equalization — bit by bit detection of the binary data sequence based on samples subject to interference and Gaussian noise
N77-11762
DATA PROCESSING TERMINALS
Developmental system for microcomputer based intelligent graphics terminals
[LA-UR-76-125] N77-11694
An efficient implementation of monitors and condition variables
[AD-A023931] N77-11697
DATA REDUCTION
Detailed design specification for the ALT Shuttle Information Extraction Subsystem [SIES]
[NASA-CR-151097] N77-11091
An analysis of data taken from the impact viscometer at Imperial College
[AD-A023143] N77-11178
Observation of the galactic hard X-ray background from the OSO-7 satellite
N77-11963
DATA STORAGE
New storage tubes
[BMFT-FB-T-76-02] N77-11298
Nonvolatile analog memories with ferroelectric elements
[BMFT-FB-T-76-11] N77-11302
The complexity of parallel algorithms
N77-11707
Antenna prediction computer problems
[AD-A024552] N77-11734
Data storage decisions for large data bases
[AD-A023874] N77-11905
DATA TRANSMISSION
Retransmission of hydrometric data in Canada
[E77-10041] N77-11501
The systematic design of communications line control procedures
N77-11744
DECISION MAKING
Partially observable Markov decision processes over an infinite planning horizon with discounting
[AD-A025077] N77-11778
Experimental evaluation of an options selection matrix as an operational decision aid
[AD-A023889] N77-11893
DAISY: An applications perspective
[AD-A023875] N77-11904
DECISION THEORY
Large-scale programming in Markov decision processes
N77-11712
Experimental evaluation of an options selection matrix as an operational decision aid
[AD-A023889] N77-11893
DECODING
Fast sequential decoding and a new complete decoding algorithm
N77-11705
Some results in majority decoding of binary cyclic codes
N77-11711
DEFECTS
Prevention of defects in powder preform forging
N77-11148
DEFLAGRATION
Ignition, combustion, detonation and quenching of reactive mixtures
[AD-A024343] N77-11060
DEGREES OF FREEDOM
Effects of modifications to the space shuttle entry guidance and control systems
[NASA-TN-D-8273] N77-11087
Control and trajectory optimization of a robot arm
[AD-A023669] N77-11688
DELAWARE
Spectral reflectance signatures of coastal pollutants — Delaware
[E77-10011] N77-11486
DELTA MODULATION
Applications of satellite technology for regional organizations [Project ASTRO]
[NASA-CR-149184] N77-11267
DELTA WINGS
Vortex/jet/wing viscous interaction theory and analysis
[AD-A025290] N77-11017
DELTAS
Use of LANDSAT data for natural resources investigation in the lower basin of Danube and Danube Delta — Romania
[E77-10032] N77-11494
DEMAND [ECONOMICS]
Societal implications of energy scarcity. Social and technological priorities in steady state and constricting systems
[PB-253097/0] N77-11556
Proceedings of the Workshop on Modeling the Interrelationships between the Energy Sector and the General Economy
[PB-255696/7] N77-11561
DENSITY DISTRIBUTION
Current problems of optical interferometry used in experimental gas dynamics
N77-11244
Maxwell yields Boltzmann t yields infinity
N77-11331
DENSITY MEASUREMENT
The electron beam fluorescence technique applied to hypersonic turbulent flows
N77-11236
Density measurement of copper shaped charge jet using the flash radiography — using equivalence of optical density and thickness in X ray absorption
[ISL-R-101/76] N77-11376
Modal density function and number of propagating modes in ducts
[NASA-TM-X-73539] N77-11817
DEPOSITION
Accretion into and emission from black holes
N77-11940
DEPTH MEASUREMENT
Inferential techniques for soil depth determinations. Part 1: Coleogyne ramosissima Torr. [Black-brush]
[AD-A024355] N77-11627
DESERTS
Geological and environmental resources investigations in Egypt using LANDSAT images
[E77-10039] N77-11499
Inferential techniques for soil depth determinations. Part 1: Coleogyne ramosissima Torr. [Black-brush]
[AD-A024355] N77-11627
DESIGN ANALYSIS
Preliminary aerosol generator design studies
[NASA-CR-150050] N77-11081
Analysis and design of ejector diffuser for optimum thrust
[AD-A025491] N77-11356
Design and construction of airport pavements on expansive soils
[AD-A028094/1] N77-11437

DESTRUCTION
Destruction by avalanche burnout — power diodes, noting IMPATT effect
[BMFT-FB-T-76-14] N77-11303
DIAMONDS
Development of high pressure devices and high pressure syntheses
[BMFT-FB-76-19] N77-11177
DIELECTRIC PERMEABILITY
A classical theory of the dielectric susceptibility of anharmonic crystals
N77-11874
DIELECTRIC PROPERTIES
Beam propagation and guiding in anisotropic media, layers and fibers
N77-11869
DIELECTRICS
Polarization-independent optical waveguides
N77-11849
DIESEL ENGINES
Hydrogen-fueled engine
[NASA-CASE-NPO-13763-1] N77-11398
DIESEL FUELS
Report of the Army Scientific Advisory Panel Ad Hoc Group on fire-safe fuels
[AD-A023763] N77-11208
DIFFERENTIAL EQUATIONS
The finite integral method applied to some problems of structural mechanics
N77-11423
DIFFERENTIAL GEOMETRY
Torsion and the geometry of spin
N77-11808
DIFFERENTIAL PRESSURE
Differential optoacoustic absorption detector
[NASA-CASE-NPO-13759-1] N77-11363
DIFFERENTIATORS
Window comparator
[NASA-CASE-FRC-10090-1] N77-11296
DIFFRACTION PATTERNS
Antenna mathematical modeling [GTD]
[AD-A025259] N77-11282
DIGITAL COMPUTERS
The systematic design of communications line control procedures
N77-11744
Queuing analysis of an IBM 370 computer system
[AD-A025270] N77-11751
DIGITAL DATA
Digital image processing
[E77-10035] N77-11496
DIGITAL FILTERS
Finite wordlength in digital signal processing
N77-11255
DIGITAL SYSTEMS
Random bit generator
[AD-A024019] N77-11748
A high performance, low cost, digitally driven electron beam lithography system
N77-11846
Spectra of Her X-1 near a turn-on in the 35-day cycle
[NASA-TM-X-71213] N77-11935
DIGITAL TO ANALOG CONVERTERS
First-Order-hold interpolation digital-to-analog converter with application to aircraft simulation
[NASA-TN-D-8331] N77-11693
DIGITAL TRANSDUCERS
Angle detector
[NASA-CASE-ARC-11036-1] N77-11364
DIMENSIONAL MEASUREMENT
Further development of a method for measuring velocity and length by laser technology
[BMFT-FB-T-76-17] N77-11377
DIODES
Performance of microwave diodes as detectors and mixers with respect to their device parameters
N77-11261
DIPOLE MOMENTS
Polarization induced surface dipole moments
[AD-A024387] N77-11159
DIRAC EQUATION
Homogeneous cosmologies with strong neutrino fields
N77-11844
DIRECTIONAL ANTENNAS
Airborne antenna polarization study for the microwave landing system
[NASA-TM-X-73952] N77-11266
DISCONTINUITY
Optical surface waveguide discontinuities
N77-11852
DISCRETE FUNCTIONS
Discrete modeling of flow systems
N77-11320
The stabilization of bilinear systems and its application to the discrete model reference adaptive control
N77-11754
DISPLACEMENT
Laser anemometry and displacement of the measurement point in industrial wind tunnels — in France
[ISL-R-116/75] N77-11370
DISPLAY DEVICES
Display/control requirements for VTOL aircraft
[NASA-CR-145026] N77-11030
Rationale and description of a coordinated cockpit display for aircraft flight management
[NASA-TM-X-3457] N77-11044
DISSOCIATION
Calculation of energetics of selected atmospheric systems. Theoretical study of dissociative-recombination of e + NO[+]
[AD-A024309] N77-11629
DISTRIBUTION FUNCTIONS
Augmenting Lehman alternatives
[AD-A023789] N77-11789
DIURNAL VARIATIONS
Conditional probabilities of the geomagnetic index A sub p
[AD-A023675] N77-11626
DIVING [UNDERWATER]
Improved thermal protection and rewarm procedures for cold water divers
[AD-A024213] N77-11660
DOCUMENTATION
OCR and its application to documentation: A state of the art review
[AGARD-AG-216] N77-11907
DOPED CRYSTALS
Development of processes for simultaneous diffusion of several dopant junction or doping elements for power devices
[BMFT-FB-T-76-16] N77-11305
Thermal conductivity of heavily doped p-type indium antimonide
N77-11876
DOPPLER EFFECT
A new technique for measuring Doppler effect
N77-11360
DOUBLE BASE ROCKET PROPELLANTS
Simple determination of the mechanical behavior of double base rocket propellants under high loading rates
N77-11195
DRAG REDUCTION
An improved projectile boattail, part 2
[AD-A024073] N77-11016
DRAINAGE
Technical manual for estimating low-flow frequency characteristics of streams in the Susquehanna River basin
[PB-255455/8] N77-11512
DRAINAGE PATTERNS
Investigations using data from LANDSAT-2 — Bangladesh
[E77-10029] N77-11492
DUCTED FLOW
Two dimensional MHD duct flow: Numerical analysis and measurements
[NLR-MP-75016-U] N77-11348
DURABILITY
Concrete aggregate durability tests
[PB-255436/8] N77-11457
DUST
Design, development, fabrication and testing of a portable self-contained respirable dust mass monitor
[PB-254503/6] N77-11681
DUST COLLECTORS
Air pollution monitoring at the Redcar site: Measurement of grit and dust [3d]
[PB-254199/3] N77-11579
DYNAMIC CHARACTERISTICS
Method of discrete modeling and its application to estimation of TF30 engine variables
[NASA-TM-X-3443] N77-11057
Compensated control loops for a 30-cm ion thruster
[NASA-TM-X-73497] N77-11100
Dynamics of the continuous settling of discrete-particle slurries
N77-11134
Lateral vibrations of an extending rod
[UTIAS-TN-202] N77-11438
DYNAMIC CONTROL
Optimal multiple-arc trajectories for an all-aspect air-to-air missile
N77-11082
Compensated control loops for a 30-cm ion thruster
[NASA-TM-X-73497] N77-11100
DYNAMIC MODELS
Method of discrete modeling and its application to estimation of TF30 engine variables
[NASA-TM-X-3443] N77-11057
Lagrange coordinate interior ballistic calculation model
[ISL-CO-215/75] N77-11205
DYNAMIC PROGRAMMING
The use of dynamic assertions to improve software quality
N77-11710
Special cases of the quadratic assignment problem
[AD-A025605] N77-11740
Dynamic programming approach to estimating gaps in large economic data bases
[LBL-4271] N77-11909
DYNAMIC RESPONSE
Analytical prediction of motor component vibrations driven by acoustic combustion instability
[AD-A025261] N77-11109
Response of linear discrete systems to modulated sequences
N77-11258
Nonlinear periodic response of a slender beam-column
N77-11435
Development of a computer program for the dynamic nonlinear response of reinforced concrete slabs under blast loading
[AD-A024050] N77-11458
Estimates of blowdown of quasi-static pressures in vented chambers
[AD-A025502] N77-11479
Statistical model of sonic boom structural damage
[AD-A028512/2] N77-11818
DYNAMIC STRUCTURAL ANALYSIS
Analytical prediction of motor component vibrations driven by acoustic combustion instability
[AD-A025261] N77-11109
Calculation of vibration modes and resonance frequencies of the Northrop NF-5
[NLR-TR-75050-U] N77-11450

E

E REGION
Numerical representation of monthly median critical frequencies of the regular E region [foE]
[PB-255484/8] N77-11276
E-2 AIRCRAFT
Fatigue investigation of the E-2B/C nose landing gear
[AD-A024072] N77-11040
EARTH ATMOSPHERE
Assimilation of surface, upper air, and grid-point data in the objective analysis procedure for a three-dimensional trajectory model
[PB-256082/9] N77-11638
EARTH CRUST
Use of satellite pictures for determining major shield fractures relevant for ore prospecting, northern Finland
[E77-10027] N77-11490
EARTH LIMB
Study of a Vuilleumier cycle cryogenic refrigerator for detector cooling on the limb scanning infrared radiometer
[NASA-CR-145078] N77-11211
EARTH RESOURCES
Resource and environmental surveys from space with the thematic mapper in the 1980's
[NASA-CR-149191] N77-11508
Research to anticipate environmental impacts of changing resource usage
[PB-256293/2] N77-11602
EARTH ROTATION
Earth and ocean modeling
[NASA-CR-150055] N77-11617
EARTH SATELLITES
Description of the universal program for calculating the navigational information on the location of an artificial earth satellite
[NASA-TT-F-17273] N77-11093
EARTH SURFACE
Earth and ocean modeling
[NASA-CR-150055] N77-11617
ECOLOGY
Ecological impacts of snowpack augmentation in the San Juan Mountains of Colorado
[PB-255012/7] N77-11514
ECONOMIC ANALYSIS
Analysis of economics of a TV broadcasting satellite for additional nationwide TV programs
[BMFT-FB-T-76-05] N77-11270
Economic impact study of the proposed motor vehicle [in-use] noise regulations
[PB-255686/8] N77-11583
Economic welfare impacts of urban noise
[PB-256411/0] N77-11933
ECONOMIC DEVELOPMENT
Energy-economy relationships
[PB-255171/1] N77-11552
ECONOMIC FACTORS
Mathematics for energy
[PB-252463/5] N77-11543
Benefit assessment of NASA space technology goals
[NASA-CR-149192] N77-11914
ECONOMICS
Dynamic programming approach to estimating gaps in large economic data bases
[LBL-4271] N77-11909
ECOSYSTEMS
The ten-ecosystem study investigation plan
[NASA-CR-151099] N77-11505
EFFECTIVE PERCEIVED NOISE LEVELS
Influence of a precursor noise on the global action potential consecutive to an impulse noise in the Guinea pig
[ISL-R-115/75] N77-11640
EGYPT
Geological and environmental resources investigations in Egypt using LANDSAT images
[E77-10039] N77-11499

EIGENVALUES
The eigenvalue spectrum of the Orr-Sommerfeld problem
[NASA-TR-R-469] N77-11344
Contributions to WKB theory
N77-11891

EIGENVECTORS
Inverse source problem: Eigenfunction analysis of Bojarski's integral equation
[AD-A025297] N77-11776

EJECTION SEATS
Ultrasonic inspection of seat-back ejection rocket motors
[AD-A024379] N77-11385

EJECTORS
Analysis and design of ejector diffuser for optimum thrust
[AD-A025491] N77-11356

ELASTIC BUCKLING
On buckling of viscoelastic plates
N77-11443

ELASTIC PLATES
Transient analysis of a three-dimensional elastic plate by the Ray grouping technique
N77-11433
On buckling of viscoelastic plates
N77-11443

ELASTIC PROPERTIES
Tresca yield condition in elastic-plastic finite element analysis
N77-11424
On the elastic stability of shells
[NASA-CR-145088] N77-11440
Conformal and non-Hertzian contact problems
N77-11811

ELASTIC SCATTERING
Pion-nucleus scattering and the investigation of nuclear spin dependent effects
N77-11836
A study of resonating group theory and alpha-helium elastic scattering
N77-11839

ELASTOHYDRODYNAMICS
Isothermal elastohydrodynamic lubrication of point contacts. III: Fully flooded results
[NASA-TN-D-8317] N77-11400

ELASTOMERS
Design and development of a 28 foot tank, elastomeric coated fabric, collapsible, petroleum from a woven tube cloth
[AD-A025595] N77-11182

ELECTRIC CONTACTS
Top collector contacted microwave power transistor; monolithic microwave lumped element integrated circuit program, phase 1
[AD-A023829] N77-11313

ELECTRIC CURRENT
Charge and current distributions on, and input impedance of moderately fat transmitting crossed-monopole antennas
[AD-A025429] N77-11283
Solar wind induced currents in the atmospheres of non-magnetic planets
N77-11953

ELECTRIC DIPOLES
Orbital motion of dipoles in electromagnetic fields
N77-11330

ELECTRIC DISCHARGES
San Joaquin Valley fog: Attempts at electrical dissipation
[AD-A023715] N77-11637

ELECTRIC ENERGY STORAGE
Hydrogen for energy storage: A progress report of technical developments and possible applications
[BNL-20931] N77-11201

ELECTRIC FIELDS
Electric field in the focal region of an offset parabolic receiving antenna
N77-11256
Large scale atmospheric electric fields: Comparisons with balloon data
N77-11608
Transport processes within a plasma driven by a high-frequency electric field
N77-11859

ELECTRIC GENERATORS
Feasibility investigation of the Giromill for generation of electrical power — computer programs
[COO-2617-75/1] N77-11536

ELECTRIC IGNITION
Motor vehicle ignition radiation with respect to the SAE standard J551C
[PB-254187/8] N77-11273

ELECTRIC NETWORKS
The spot frequency design of optimum embedding networks for RF switching, modulation, and phase shifting using power limited switches
N77-11284
Thin film circuits for future applications. Part 1: Basic investigations and sputtering technique
[BMFT-FB-T-76-20] N77-11306
Solution of networks containing a trichotomized class of elements
N77-11714

ELECTRIC POWER
Electric energy supply alternatives for New York. Phase 2: An appraisal of electrical energy alternatives available to the State of New York
[PB-249881/4] N77-11575

ELECTRIC POWER PLANTS
Selected aspects of waste heat management: A state-of-the-art study
[PB-255697/5] N77-11563
West Virginia power plant evaluation
[PB-255460/8] N77-11592
Theoretical, numerical, and physical techniques for characterizing power plant plumes
[PB-253099/6] N77-11599

ELECTRIC POWER SUPPLIES
New methods for improving the stability of power diodes
[BMFT-FB-T-76-09] N77-11300
Development of processes for simultaneous diffusion of several dopant junction or doping elements for power devices
[BMFT-FB-T-76-16] N77-11305

ELECTRIC POWER TRANSMISSION
Time domain filtering, estimation and prediction techniques in power systems
N77-11285

ELECTRICAL PROPERTIES
Properties of Cr-SiO2-n Si tunnel diodes
N77-11291
Electrical characteristics for rectangular conductors — using four computer programs
[SAND-75-0626] N77-11297

ELECTRICAL RESISTIVITY
Ground resistance for MF/HF design analysis of grounded antenna systems
[AD-A025090] N77-11281
Electrical characteristics for rectangular conductors — using four computer programs
[SAND-75-0626] N77-11297
Electrical transport properties of itinerant and localized electron magnetic systems
N77-11878

ELECTRO-OPTICS
Laser applications in flight control — and optoelectronics applications
N77-11391

ELECTROCARDIOGRAPHY
Changes in clinical cardiologic measurements associated with high +G sub z stress
N77-11645

ELECTROCHEMICAL CELLS
Hydrogen for energy storage: A progress report of technical developments and possible applications
[BNL-20931] N77-11201

ELECTROCHEMISTRY
Electrochemical analysis of sulfidic and amine odorants
[PB-255092/9] N77-11591

ELECTRODES
Sensors for continuous monitoring of toxic ions, nutrients, and dissolved gases in water
[PB-254834/5] N77-11387

ELECTROENCEPHALOGRAPHY
Stress response and stress tolerance in fighter pilots during 6 G manoeuvers
N77-11653

ELECTROLYSIS
Electrolytic pretreatment unit gaseous effluent conditioning
[NASA-CR-151101] N77-11671

ELECTROLYTES
Preparation and properties of beta-alumina/glass composites
[PB-255549/8] N77-11130
Electrolytic hydrogen in beta titanium
N77-11146
Solid Polymer Electrolyte [SPE] fuel cell technology, program review, phase 2
[NASA-CR-150957] N77-11532
Semiconductor-electrolyte photovoltaic energy converter
[PB-252837/0] N77-11548
Ionic conductivity in the sodium gallates
N77-11872

ELECTROMAGNETIC FIELDS
Radiation from a current filament driven by a traveling wave
[NASA-TN-D-8302] N77-11294
Orbital motion of dipoles in electromagnetic fields
N77-11330

ELECTROMAGNETIC NOISE
Robustized recursive estimators and adaptive partition detectors
N77-11259

ELECTROMAGNETIC PULSES
The electromagnetic pulse [EMP] — effect on military electronic equipment
[AD-A023775] N77-11277

ELECTROMIGRATION
A study of electromigration in microwave power transistors
N77-11290

ELECTRON BEAMS
Applications of non-intrusive instrumentation in fluid flow research — including Raman spectra, Laser Doppler Velocimeters, and electron beams; conference proceedings
[AGARD-CP-193] N77-11221
The electron beam fluorescence technique applied to hypersonic turbulent flows
N77-11236
Characterization of noise sources in hot jets by the crossed beam technique
N77-11238
Development of the electron beam fluorescence technique for measurements in a hypersonic turbulent flow
N77-11326
Optical and laser-interferometric investigations of an electron-beam-controlled CO2-laser
[ISL-35/74] N77-11392
Efficient high-energy HCl chemical laser
[AD-A023787] N77-11393
A high performance, low cost, digitally driven electron beam lithography system
N77-11846
Nonrelativistic electron stream propagation in the solar atmosphere and solar wind: Type 3 bursts
N77-11952

ELECTRON BOMBARDMENT
Electron bombardment propulsion system characteristics for large space systems
[NASA-TM-X-73554] N77-11106

ELECTRON DISTRIBUTION
A photocurrent spectroscopic method for determination of trapping state distributions in silicon dioxide thin films
N77-11875

ELECTRON EMISSION
Technological studies of high mission current density cathodes
[BMFT-FB-T-76-10] N77-11301

ELECTRON ENERGY
KKR analysis of the Anderson-McMillan theory of electronic structure of liquid metals
[AD-A024386] N77-11887

ELECTRON GUNS
Repetitively pulsed cold cathode studies
[AD-A024354] N77-11317

ELECTRON IMPACT
Electron impact ionization cross sections of gold, chromium and iron
[AD-A024208] N77-11834

ELECTRON MICROSCOPY
Electron-microscopical studies of passive films on stainless steels
[PB-255190/1] N77-11168
The epitaxial growth of thin films and the interfacial dislocations studied by RHEED and transmission electron microscopy
N77-11868

ELECTRON MOBILITY
Investigation of electronic transport, recombination and optical properties in In As sub 1-x P sub x alloy systems
[AD-A025294] N77-11889

ELECTRON PUMPING
Pump wavenumber dependent effects in the parametric instabilities of a plasma
N77-11863

ELECTRON SCATTERING
An invariant imbedding, orders-of-scattering approach to particle transport in a slab
[AD-A024155] N77-11832

ELECTRON TUBES
New storage tubes
[BMFT-FB-T-76-02] N77-11298
Rapid electrographic and electrophotographic processes. Lenard window for electrostatic printing tubes — in reproduction equipment
[BMFT-FB-T-76-06] N77-11299

ELECTRONIC CONTROL
Bosch technical instruction. Gasoline injection D and L-jetronic
[NASA-TT-F-17111] N77-11399

ELECTRONIC EQUIPMENT
The electromagnetic pulse [EMP] — effect on military electronic equipment
[AD-A023775] N77-11277

ELECTRONIC FILTERS
Time domain filtering, estimation and prediction techniques in power systems
N77-11285

ELECTROSTATIC CHARGE
Rapid electrographic and electrophotographic processes. Lenard window for electrostatic printing tubes — in reproduction equipment
[BMFT-FB-T-76-06] N77-11299

ELECTROSTATIC PRECIPITATORS
Particulate collection efficiency measurements on an electrostatic precipitator installed on a paper mill recovery boiler
[PB-255297/4] N77-11596

ELLIPTIC DIFFERENTIAL EQUATIONS
Mixed-hybrid finite element approximations of second-order elliptic boundary-value problems
[ORO-3443-59] N77-11766

EMBEDDING
The spot frequency design of optimum embedding networks for RF switching, modulation, and phase shifting using power limited switches
N77-11284

EMBRITTLEMENT
Embrittlement of carbon steels and iron by indium
N77-11149

EMISSION SPECTRA
Radiation from a collection of absorbing resonant systems in the presence of boundaries of intense fields
N77-11828
Accretion into and emission from black holes
N77-11940

ENDOTHERMIC REACTIONS
Steady-state multiplicity of catalytic reaction systems
N77-11132

ENERGY ABSORPTION
Spectra of Her X-1 near a turn-on in the 35-day cycle
[NASA-TM-X-71213] N77-11935

ENERGY BANDS
One-electron energy bands of silicon dioxide in the ideal beta cristobalite structure
N77-11882

ENERGY CONSERVATION
Aircraft fuel conservation technology. Task force report, September 10 1975
[NASA-TM-X-74295] N77-11055
Total energy management: A practical handbook on energy conservation and management
[PB-254683/6] N77-11554
The Chicago Project: Evaluation and testing of three types of energy audit processes for school buildings
[PB-255321/2] N77-11555
Energy conservation through effective energy utilization: 1973 Engineering Foundation Conference
[PB-255878/1] N77-11560
Conference report: Energy Conservation in Transportation and Construction
[PB-255857/5] N77-11562
Assessing the relationship between urban form and travel requirements: A literature review and conceptual framework
[PB-254988/9] N77-11923

ENERGY CONSUMPTION
Energy-economy relationships
[PB-255171/1] N77-11552
Energy information activities at the FEA
[PB-253962/5] N77-11553
Energy use in the contract construction industry
[PB-245422/1] N77-11557

ENERGY CONVERSION
Methanol from coal fuel and other applications
[ORAU-126] N77-11200
Problems and solutions in the use of coal analyses
[FE-0390-1] N77-11535

ENERGY CONVERSION EFFICIENCY
Evaluation of flat-plate collector efficiency under controlled conditions in a solar simulator
[NASA-TM-X-73520] N77-11530
Solid Polymer Electrolyte [SPE] fuel cell technology, program review, phase 2
[NASA-CR-150957] N77-11532

ENERGY DISSIPATION
Measurements of energy losses, distributions of energy loss and additivity of energy losses for 50 to 150 KeV protons in hydrogen and nine hydrocarbon gases
N77-11823

ENERGY DISTRIBUTION
Measurements of energy losses, distributions of energy loss and additivity of energy losses for 50 to 150 KeV protons in hydrogen and nine hydrocarbon gases
N77-11823

ENERGY LEVELS
Transformation of high energy electrons to muons in the Coulomb field of a nucleus
N77-11841

ENERGY POLICY
Mandatory Canadian crude oil allocation regulations
[PB-255319/6] N77-11509
Identification and analysis of mid-Atlantic onshore OCS impact
[PB-254925/1] N77-11516
Multi-year time frame optimization of power systems with fossil, nuclear, hydro, pumped storage and peaking units
N77-11525
National program for solar heating and cooling [residential and commercial applications]
[ERDA-23A] N77-11540
Mathematics for energy
[PB-252463/5] N77-11543
Energy information activities at the FEA
[PB-253962/5] N77-11553
Societal implications of energy scarcity. Social and technological priorities in steady state and constricting systems
[PB-253097/0] N77-11556
Proceedings of the Workshop on Modeling the Interrelationships between the Energy Sector and the General Economy
[PB-255696/7] N77-11561
Electric energy supply alternatives for New York. Phase 2: An appraisal of electrical energy alternatives available to the State of New York
[PB-249881/4] N77-11575
Research to anticipate environmental impacts of changing resource usage
[PB-256293/2] N77-11602
Future scenarios for urban transportation
[PB-255349/3] N77-11930

ENERGY REQUIREMENTS
The contribution of nuclear technology toward the solution of energy problems
[INIS-MF-1867] N77-11565

ENERGY SOURCES
ERDA energy information data base: Magnetic tape description
[TID-4581-R3] N77-11695

ENERGY TECHNOLOGY
Hydrogen for energy storage: A progress report of technical developments and possible applications
[BNL-20931] N77-11201
A basis for analyzing prospective power generation in terms of environmental management and energy use
N77-11526
Electric energy supply alternatives for New York. Phase 2: An appraisal of electrical energy alternatives available to the State of New York
[PB-249881/4] N77-11575

ENERGY TRANSFER
Energy transfer between inorganic ions in glasses
[AD-A023910] N77-11141
Electronic angular momentum transfer in the I[doublet P[1/2]] + NF [a singlet delta] system
[AD-A024258] N77-11833

ENGINE CONTROL
Method of discrete modeling and its application to estimation of TF30 engine variables
[NASA-TM-X-3443] N77-11057

ENGINE NOISE
Simulation of flight-type engine fan noise in the NASA-Lewis 9X15 anechoic wind tunnel
[NASA-TM-X-73540] N77-11050
Effects of forward velocity on noise for a J85 turbojet engine with multitube suppressor from wind tunnel and flight tests
[NASA-TM-X-73542] N77-11051
Macroscopic study of time unsteady noise of an aircraft engine during static tests
[NASA-TM-X-73556] N77-11052
Core noise source diagnostics on a turbofan engine using correlation and coherence techniques
[NASA-TM-X-73535] N77-11053

ENGINES
High temperature thermocouple system for advanced aircraft turbine engines
[AD-A025500] N77-11062

ENGLISH LANGUAGE
A demonstration of the feasibility of using English as a programming language
N77-11708
Practical natural language processing. The REL system as prototype
[AD-A024313] N77-11731

ENTRAINMENT
Investigation of performance limits in axial groove heat pipes
[NASA-CR-137912] N77-11340

ENTROPY
Finite-difference approximations and entropy conditions for shocks
[COO-3077-106] N77-11764

ENVIRONMENT EFFECTS
An assessment of estuarine and nearshore marine environments
[PB-254853/5] N77-11598

ENVIRONMENT MANAGEMENT
The use of remote sensing devices for acquiring data for environmental management purposes. Report 2: Application of photographic remote sensors to an environmental management problem
[AD-A025616] N77-11519
Optimal management of the subsurface environment: Parameter identification
[PB-255648/8] N77-11921

ENVIRONMENT PROTECTION
Draft environmental assessment of application by ERDA for a special land use permit for use of public lands in Wyoming for in situ coal gasification experiments
[UCID-17011] N77-11572
Environmental impact studies related to underground coal gasification
[TID-27003] N77-11573
Research to anticipate environmental impacts of changing resource usage
[PB-256293/2] N77-11602
Justifications of appropriation estimates for Committee on Appropriations, fiscal year 1976
[PB-256464/9] N77-11604

ENVIRONMENTAL MONITORING
Design of pollutant-oriented integrated monitoring systems. A test case: Environmental lead
[PB-255103/4] N77-11595
Airport noise monitoring systems, task A
[AD-A028511/4] N77-11821

ENVIRONMENTAL QUALITY
Radiological quality of the environment
[PB-254615/8] N77-11636

ENVIRONMENTAL SURVEYS
Identification and analysis of mid-Atlantic onshore OCS impact
[PB-254925/1] N77-11516
Strategic petroleum reserve
[PB-255476/4] N77-11546
Environmental impact computer system attribute descriptor package: Reference document
[AD-A024303] N77-11582
Design of pollutant-oriented integrated monitoring systems. A test case: Environmental lead
[PB-255103/4] N77-11595
Regional air pollution study: Quality assurance audits
[PB-255313/9] N77-11605
Global measurements of gaseous and aerosol trace species in the upper troposphere and lower stratosphere from daily flights of 747 airliners
[NASA-TM-X-73544] N77-11612

EPITAXY
The epitaxial growth of thin films and the interfacial dislocations studied by RHEED and transmission electron microscopy
N77-11868

EPOXY RESINS
Investigation of stress levels causing significant damage in composites
[AD-A024537] N77-11127

EQUATIONS OF MOTION
Mathematical modelling for an unsteady vertically stratified flow field
N77-11335
Dynamics of inertia variant machinery
N77-11809

EQUATIONS OF STATE
Composition and equation of state of thermally dissociated matter and mass and stability of rigidly rotating relativistic polytropes
N77-11843

EQUATORS
Nonlinear equatorial spread F
[AD-A024440] N77-11623

EROSION
Study of erosion mechanisms of engineering ceramics
[AD-A025258] N77-11184

ERROR ANALYSIS
RM2: rms error comparisons
[NASA-CR-149150] N77-11717

ERROR DETECTION CODES
Iterated codes with improved performance
N77-11704

ERROR FUNCTIONS
Control by model error estimation
[NASA-CR-150059] N77-11755

ESTIMATES
A Bayesian approach to two-stage sampling
[AD-A025624] N77-11796

ESTIMATING
On estimation of regression coefficients
N77-11760
Dynamic programming approach to estimating gaps in large economic data bases
[LBL-4271] N77-11909

ESTUARIES
Sediment studies in Back River Estuary, Baltimore, Maryland
[PB-255584/5] N77-11594
An assessment of estuarine and nearshore marine environments
[PB-254853/5] N77-11598

ETCHING
Periodic integrated optical structures in photoresist: Application to grating couplers
N77-11847

EULER EQUATIONS OF MOTION
Analysis of the perturbed motion of asymmetric, spinning spacecraft
[NLR-TR-75043-U] N77-11097

EUROPE
On the flow quality necessary for the Large European High-Reynolds-Number Transonic Windtunnel LEHRT
[AGARD-R-644] N77-11070

EUTECTICS
Refinement of promising coating compositions for directionally cast eutectics
[NASA-CR-135103] N77-11154

EVAPORATION
Thin film circuits for future applications. Part 2: Evaporation technique
[BMFT-FB-T-76-21] N77-11307

EXCITATION
Laser induced fluorescence as a spectroscopic tool
N77-11131

Transient analysis of a three-dimensional elastic plate by the Ray grouping technique
N77-11433

EXHAUST DIFFUSERS
Analysis and design of ejector diffuser for optimum thrust
[AD-A025491] N77-11356

EXHAUST GASES
High temperature thermocouple system for advanced aircraft turbine engines
[AD-A025500] N77-11062
Space shuttle contamination due to backflow from control motor exhaust
[NASA-CR-150054] N77-11092
Reduction of gaseous pollutant emissions from gas turbine combustors using hydrogen-enriched jet fuel
[NASA-CR-149146] N77-11198
MIUS systems analysis: Effects of unfavorable meteorological conditions and building configurations on air quality
[ONRL/HUD/MIUS-29-ADD-2] N77-11571
An evaluation of high altitude engine modification devices [econo-kit]
[PB-255556/3] N77-11589
Investigation and assessment of light-duty-vehicle evaporative emission sources and control
[PB-255813/8] N77-11603

EXHAUST NOZZLES
OTW noise correlation for several nozzle/wing geometries using a 5:1 slot nozzle with external deflectors
[NASA-TM-X-73529] N77-11815

EXOSPHERE
The lunar exosphere
N77-11949

EXPANDABLE STRUCTURES
Design and construction of airport pavements on expansive soils
[AD-A028094/1] N77-11437

EXPERIMENTAL DESIGN
Conceptual designs for a modular remotely piloted vehicle
[AD-A023844] N77-11035
Necessary conditions for the existence of some incomplete block designs
[AD-A025856] N77-11779

EXPLOSIVES
Behavior of various condensated explosives to shock waves calibrated in intensity and duration — using explosive lateral projection technique
[ISL-CO-211/75] N77-11204

EXPONENTIAL FUNCTIONS
On the exponential map of a Lie group
N77-11805

EXPONENTS
Computational algorithms for coding bound exponents
N77-11715

EXTENSIONS
Lateral vibrations of an extending rod
[UTIAS-TN-202] N77-11438

EXTREMELY LOW RADIO FREQUENCIES
Earth magnetism, the aurora and ultralow-frequency radiation
[NASA-TT-F-16737] N77-11616

EXTRUDING
Computer-aided design and manufacturing for extrusion of aluminum, titanium, and steel structural parts [phase 1]
[AD-A023946] N77-11171

EYE MOVEMENTS
Computerized analysis of eye movements during static display visual search
[AD-A024100] N77-11680

F

F REGION
The construction of storm-time corrections for ionospheric F-region parameters and their application to trans-ionospheric group-path delay
[AD-A024408] N77-11621
Nonlinear equatorial spread F
[AD-A024440] N77-11623

F-5 AIRCRAFT
Calculation of vibration modes and resonance frequencies of the Northrop NF-5
[NLR-TR-75050-U] N77-11450

F-15 AIRCRAFT
A wind tunnel captive aircraft testing technique
[AD-A023690] N77-11037

F-27 AIRCRAFT
Certification of the replacement of glass fabric per mat. spec. 5.670/1, with glass fabric per mat. spec. 5.670 in the F27 plastic sandwich wing-and-stabilizer-leading edges — noting shear strength and sandwich stiffness
[FOK-R-1876] N77-11122

FABRICATION
Design and fabrication of an 8000 PSI control-by-wire actuator for flight testing in a T-2 C airplane
[AD-A024487] N77-11065

FABRICS
Certification of the replacement of glass fabric per mat. spec. 5.670/1, with glass fabric per mat. spec. 5.670 in the F27 plastic sandwich wing-and-stabilizer-leading edges — noting shear strength and sandwich stiffness
[FOK-R-1876] N77-11122
Design and development of a 28 foot tank, elastomeric coated fabric, collapsible, petroleum from a woven tube cloth
[AD-A025595] N77-11182

FABRY-PEROT INTERFEROMETERS
Supersonic velocity and turbulence measurements using a Fabry-Perot interferometer
N77-11227

FACE CENTERED CUBIC LATTICES
Grain boundary structures and energies in fcc-iron
[HEDL-SA-1002] N77-11884

FACTOR ANALYSIS
Analysis of a simple factorization algorithm
[AD-A024416] N77-11790
Project screening
[AD-A023837] N77-11894

FANS
Simulation of flight-type engine fan noise in the NASA-Lewis 9X15 anechoic wind tunnel
[NASA-TM-X-73540] N77-11050

FAR INFRARED RADIATION
Far-infrared recombination radiation from impact-ionized shallow donors in n-type GaAs in high magnetic fields
N77-11880

FAST FOURIER TRANSFORMATIONS
Finite wordlength in digital signal processing
N77-11255
A study of fast transform algorithms
N77-11709

FAST NEUTRONS
Studies of thick target fast neutron production and proton activation of the stable isotope tracer Ca-48 as applications of nuclear physics in medicine
N77-11837

FATIGUE [BIOLOGY]
Pilot workload and fatigue: A critical survey of concepts and assessment techniques
[NASA-TN-D-8365] N77-11674

FATIGUE [MATERIALS]
Effect of microstructure on the fatigue crack growth of a powder metallurgy nickel-base superalloy
N77-11153
Development of high fracture toughness in maraging steels
[AD-A025096] N77-11172
On the nature of the closure phenomena and its effect on fatigue crack growth rate
N77-11431
Characterization of fatigue cracks with ultrasonics
N77-11432

FATIGUE LIFE
Fatigue investigation of the E-2B/C nose landing gear
[AD-A024072] N77-11040
Application of design data derived from fatigue tests with service-like load sequences for life prediction — wing structures of transport aircraft
[LBF-FB-109/76] N77-11445
Significance of measured local strains for the fatigue strength of joints
[LBF-FB-128/76] N77-11446
Compilation of measures to increase the fatigue strength of aircraft structures
[LBF-TB-126/75] N77-11447
Current practice on estimating crack growth damage accumulation with specific application to structural safety durability and reliability
[AD-A025499] N77-11478

FATIGUE TESTS
Catapult launch fatigue investigation of the model S-2 E airplane
[AD-A024071] N77-11038
Cyclic structural analysis of air-cooled gas turbine blades and vanes
[NASA-TM-X-73494] N77-11439
Mechanism of material fatigue during the crack initiation stage
[ICAF-DOC-895] N77-11441
Application of design data derived from fatigue tests with service-like load sequences for life prediction — wing structures of transport aircraft
[LBF-FB-109/76] N77-11445

FEASIBILITY ANALYSIS
Flight test demonstration of selected curved-segmented approach paths based on microwave landing system guidance
[AD-A025501] N77-11028
Study of the feasibility of federal procurement of fuels produced from solid wastes
[PB-255695/9] N77-11513
Selected priorities: 1978-82. A first-year effort recommending priorities for selected Federal water and related land resource programs in New England
[PB-255890/6] N77-11600
A demonstration of the feasibility of using English as a programming language
N77-11708

FEDERAL BUDGETS
Justifications of appropriation estimates for Committee on Appropriations, fiscal year 1976
[PB-256464/9] N77-11604

FEEDBACK CONTROL
Disturbance rejection and two classes of multivariable PI controllers with application to turbine-generator control
N77-11396
Control and trajectory optimization of a robot arm
[AD-A023669] N77-11688

FERROELECTRICITY
Nonvolatile analog memories with ferroelectric elements
[BMFT-FB-T-76-11] N77-11302

FERROMAGNETIC MATERIALS
Field effect in ferromagnetic metals
N77-11881

FIBER OPTICS
Development of an optical fiber video data link
[AD-A025220] N77-11027

FIBER ORIENTATION
Strain rate effects on mechanical properties of fiber composites, part 3
[NASA-CR-135087] N77-11116

FIELD ARMY BALLISTIC MISSILES
Small solid propellant rockets for field use
[AGARD-CP-194] N77-11185

FIELD THEORY [ALGEBRA]
Higher K-theory of regular rings
N77-11804

FIELD THEORY [PHYSICS]
A study of some two-dimensional field theory models
N77-11835
The renormalisation group and scaling at high energy in Yukawa field theory
N77-11842

FIGHTER AIRCRAFT
Military rocket aircraft: Inherent constraints and their uses
N77-11186

FILM COOLING
Two-dimensional cold-air cascade study of a film-cooled turbine stator blade. 3: Effect of hole size on single-row and multirow ejection
[NASA-TM-X-3442] N77-11007
Investigation of slot cooling for high-speed aircraft
[AD-A024316] N77-11061

FILM THICKNESS
Isothermal elastohydrodynamic lubrication of point contacts. III: Fully flooded results
[NASA-TN-D-8317] N77-11400

FILTERS
Investigation and optimum design of the generalized second-order phase-locked loop
N77-11264

FINITE DIFFERENCE THEORY
Two dimensional MHD duct flow: Numerical analysis and measurements
[NLR-MP-75016-U] N77-11348
The finite integral method applied to some problems of structural mechanics
N77-11423
Finite-difference approximations and entropy conditions for shocks
[COO-3077-106] N77-11764
Multidimensional difference schemes with fourth order accuracy
[AD-A023766] N77-11771

FINITE ELEMENT METHOD
Tresca yield condition in elastic-plastic finite element analysis
N77-11424
Three-dimensional finite element analysis of a large circular disc with circular penetrations
[WAPD-TM-1206] N77-11444
Calculation of vibration modes and resonance frequencies of the Northrop NF-5
[NLR-TR-75050-U] N77-11450
Revised aircraft load curves and vehicle ice-thickness tables for annual ice sheet operations near McMurdo, Antarctica
[AD-A024051] N77-11461
APES: Second generation two-dimensional fracture mechanics and stress analysis by finite elements
[AD-A025217] N77-11474
Mixed-hybrid finite element approximations of second-order elliptic boundary-value problems
[ORO-3443-59] N77-11766

FINLAND
Use of satellite pictures for determining major shield fractures relevant for ore prospecting, northern Finland
[E77-10027] N77-11490

FIRE DAMAGE
Analysis of reinforced concrete beams subjected to fire
[PB-256425/0] N77-11471

FIRE FIGHTING
Aircraft ground fire suppression and rescue systems. Characteristics of kinematic jet fuel fires cascading and rod fuel geometries
[AD-A024447] N77-11022

FIRE PREVENTION
Investigation into the influence of natural weathering on the fire resistant property of FFP 5.552 [F-coat]
[FOK-R-1932] N77-11176
Report of the Army Scientific Advisory Panel Ad Hoc Group on fire-safe fuels
[AD-A023763] N77-11208
Fire loads and live loads in buildings
[PB-255864/1] N77-11218
Development of electronic circuits for advanced high temperature fire detectors
[AD-A023843] N77-11318
FIREPROOFING
Investigation into the influence of natural weathering on the fire resistant property of FFP 5.552 [F-coat]
[FOK-R-1932] N77-11176
FIRST AID
Potential role of remote sensing in disaster relief management
[NASA-CR-149102] N77-11502
FISHES
LANDSAT menhaden and thread herring resources investigation, Gulf of Mexico
[E77-10036] N77-11497
FISSION PRODUCTS
Charge and mass identification of fission fragments
N77-11110
FIXED WINGS
Controlled and uncontrolled flow separation in three dimensions
[LR-591] N77-10999
FLAME SPECTROSCOPY
Automated wavelength selection for flame spectroscopy
[AECL-5311] N77-11137
Laser Raman diagnostics of aerodynamic flows and flames
N77-11234
FLAME STABILITY
Pollutant formation and multiple stationary states in radiantly stabilized flames
N77-11133
FLAT PLATES
Numerical investigation of the flow of a stratified fluid past a flat plate
N77-10996
Army preliminary evaluation YOH-58A helicopter with a flat-plate canopy
[AD-A024501] N77-11039
Evaluation of flat-plate collector efficiency under controlled conditions in a solar simulator
[NASA-TM-X-73520] N77-11530
FLEXIBILITY
Follow-up study for the California resilience design method
[PB-255121/6] N77-11454
Improvement of Utah's flexible pavement performance system
[PB-254819/6] N77-11462
FLEXIBLE BODIES
Vibration of a flexible spacecraft with momentum exchange controllers
N77-11095
Vibration of a flexible spacecraft with momentum exchange controllers
[NASA-CR-150058] N77-11096
FLIGHT CONTROL
Preliminary design-lift/cruise fan research and technology airplane flight control system
[NASA-CR-137971] N77-11064
Helicopter yaw axis augmentation investigation
[AD-A024512] N77-11066
Laser applications in flight control — and optoelectronics applications
N77-11391
FLIGHT CREWS
SAINT II documentation manual
[AD-A024286] N77-11689
FLIGHT SIMULATION
First-Order-hold interpolation digital-to-analog converter with application to aircraft simulation
[NASA-TN-D-8331] N77-11693
FLIGHT SIMULATORS
Design and performance of the four-degrees-of-freedom motion system of the NLR research flight simulator
[NLR-MP-75038-U] N77-11072
FLIGHT TESTS
A flight investigation of piloting techniques and crosswind limitations during visual STOL-type landing operations
[NASA-TN-D-8284] N77-11001
Flight test demonstration of selected curved-segmented approach paths based on microwave landing system guidance
[AD-A025501] N77-11028
FLIGHT TIME
The time-of-flight laser anemometer
N77-11243
FLIGHT TRAINING
Crew training and support activities
[GPO-75-984] N77-11678
FLOOD PREDICTIONS
The LANDSAT satellite and flood control in New England, June 1976
[E77-10026] N77-11489
FLOW CHARACTERISTICS
Technical manual for estimating low-flow frequency characteristics of streams in the Susquehanna River basin
[PB-255455/8] N77-11512
FLOW DIRECTION INDICATORS
Flow direction measurements in the tandem test sections of the model subsonic wind tunnel [MUK]
[DLR-IB-151-76/1] N77-11074
FLOW DISTRIBUTION
Heat-transfer distributions on a 0.013-scale shuttle solid rocket booster at Mach 3.70 and angles of attack from 0 deg to 180 deg
[NASA-TM-X-3417] N77-10995
The AFFDL-Nielsen flow-field study
[AD-A023755] N77-11015
Optical measurements of thermodynamic properties in flow fields. A review
N77-11233
Qualitative and quantitative flow field visualization utilizing laser-induced fluorescence
N77-11237
Mathematical modelling for an unsteady vertically stratified flow field
N77-11335
Evaluation of mean and turbulent velocity measurements in subsonic accelerated boundary layers
[NASA-TN-D-8367] N77-11343
An assessment of flow quality requirements for the compressor research facility
[AD-A023888] N77-11408
FLOW EQUATIONS
The Knudsen flow between oblique plates
[REPT-1/1976] N77-11347
FLOW MEASUREMENT
Flow direction measurements in the tandem test sections of the model subsonic wind tunnel [MUK]
[DLR-IB-151-76/1] N77-11074
Applications of non-intrusive instrumentation in fluid flow research — including Raman spectra, Laser Doppler Velocimeters, and electron beams; conference proceedings
[AGARD-CP-193] N77-11221
Applications of the laser Doppler velocimeter to measure subsonic and supersonic flows
N77-11223
Development of photon correlation anemometry for application to supersonic flows
N77-11231
Measurement of periodic flows using laser Doppler correlation techniques
N77-11232
Experimental investigation of coaxial turbulent jets
N77-11337
Two dimensional MHD duct flow: Numerical analysis and measurements
[NLR-MP-75016-U] N77-11348
New applications of laser anemometry to turbulent flow
[ISL-CO-212/75] N77-11349
Laser anemometry and displacement of the measurement point in industrial wind tunnels — in France
[ISL-R-116/75] N77-11370
Investigating complex aerodynamic flows with a laser velocimeter
[NASA-TM-X-73171] N77-11390
FLOW STABILITY
The effects of wall temperature and suction on laminar boundary-layer stability
[AD-A025337] N77-11355
On renormalized kinetic theories of anomalous transport due to hydrodynamic fluctuations in strongly magnetized plasma
N77-11862
Modeling dynamic processes in planetary atmospheres. Part 1: Apparatus for studying shear flow stability in spherical layers, preliminary results
[NASA-TT-F-17262] N77-11951
FLOW VELOCITY
Data acquisition and processing system for spectral analysis of the temporal velocity variations in a gas flow — using laser anemometry
[ISL-R-127/75] N77-11373
Comparison of laser anemometry methods of several laboratories. Report on ISL measurements carried out 5 - 8 November 1974 — two-focus and Doppler anemometry
[ISL-R-129/75] N77-11374
Velocity limitations in coaxial plasma gun experiments with gas mixtures
[TRITA-EPP-76-02] N77-11865
FLOW VISUALIZATION
Qualitative and quantitative flow field visualization utilizing laser-induced fluorescence
N77-11237
Resonant Doppler velocimeter
N77-11239
Holographic flow visualization — of aircraft wakes
[NASA-CR-149182] N77-11365
FLOWMETERS
CALFLO: A basic language program used in the calibration of Vol-O-Flow meters
[AD-A025466] N77-11388
FLUES
Field test sampling/analytical strategies and implementation cost estimates: Coal gasification and flue gas desulfurization
[PB-254166/2] N77-11581
FLUID DYNAMICS
Added mass and damping forces on circular cylinders
[AD-A024037] N77-11353
Fluid Dynamics Panel Symposium on Flow Separation
[AGARD-AR-98] N77-11357
Transients in turbocompressors — effect of unsteady flow on compressor performance
[AD-A024275] N77-11412
FLUID FILMS
An experimental and analytical study of the sputtering phenomena
N77-11336
FLUID FLOW
Applications of non-intrusive instrumentation in fluid flow research — including Raman spectra, Laser Doppler Velocimeters, and electron beams; conference proceedings
[AGARD-CP-193] N77-11221
The use of rotating radial diffraction gratings in laser Doppler velocimetry
N77-11242
A three-component laser-Doppler-velocimeter
N77-11248
Discrete modeling of flow systems
N77-11320
Dynamic behavior of fluid-tank systems
N77-11325
FLUIDICS
CALFLO: A basic language program used in the calibration of Vol-O-Flow meters
[AD-A025466] N77-11388
FLUORESCENCE
Laser induced fluorescence as a spectroscopic tool
N77-11131
Fringe mode fluorescence velocimetry
N77-11240
Development of the electron beam fluorescence technique for measurements in a hypersonic turbulent flow
N77-11326
FLUORINE COMPOUNDS
Pulse NMR in solids: Chemical shift, lead fluoride and thorium hydride
N77-11873
FLUOROCARBONS
Structure-property relationships bibenzoxazole polymers containing fluorocarbon linkages
[AD-A023822] N77-11180
FLUOROHYDROCARBONS
Structure-property relationships bibenzoxazole polymers containing fluorocarbon linkages
[AD-A023822] N77-11180
FLUTTER ANALYSIS
Development of a graphite horizontal stabilizer
[AD-A023767] N77-11036
FLY BY WIRE CONTROL
Design and fabrication of an 8000 PSI control-by-wire actuator for flight testing in a T-2 C airplane
[AD-A024487] N77-11065
FLYWHEELS
Rim-spoke composite flywheels: Stress and vibration analysis
[NASA-TN-D-8339] N77-11442
FOG DISPERSAL
San Joaquin Valley fog: Attempts at electrical dissipation
[AD-A023715] N77-11637
FORCED CONVECTION
A study of internal forced convective boiling heat transfer for binary mixtures
N77-11332
FORECASTING
A canonical analysis of multiple time series
[AD-A023861] N77-11773
Future scenarios for urban transportation
[PB-255349/3] N77-11930
FORESTS
ERTS-B applications to Minnesota resource management
[E77-10005] N77-11485
Development of remote sensing technology in New Zealand, part 1. Seismotectonic, structural, volcanologic and geomorphic study of New Zealand, part 2. Indigenous forest assessment, part 3. Mapping land use and environmental studies in New Zealand, Part 4. New Zealand forest service LANDSAT projects, part 5. Geographical applications in LANDSAT mapping: Landuse mapping and environmental studies, part 6
[E77-10040] N77-11500
FORTRAN
A FORTRAN program for the computation of two-dimensional or axisymmetric nozzles — applied to supersonic free jets
[ISL-R-110/75] N77-11012

Description of the universal program for calculating the navigational information on the location of an artificial earth satellite
[NASA-TT-F-17273] N77-11093
TREND: A program using cumulative sum methods to detect long-term trends in data
[AECL-5262] N77-11723
A FORTRAN computer program for calculating the linear prolate functions
[AD-A025210] N77-11742
FOSSIL FUELS
Strategic petroleum reserve
[PB-255476/4] N77-11546
Meeting report: Advanced fossil fuels sector group
[PB-255117/4] N77-11549
FOURIER TRANSFORMATION
Fourier integral methods for static and dynamic problems in microstrip N77-11293
FRACTIONATION
Effect of sustained +G sub z acceleration on cardiac output and fractionation of cardiac output in awake miniature swine N77-11650
FRACTURE MECHANICS
Studies of the kinetics of environmental hydrogen embrittlement in titanium alloys N77-11151
APES: Second generation two-dimensional fracture mechanics and stress analysis by finite elements
[AD-A025217] N77-11474
FRACTURE STRENGTH
Development of high fracture toughness in maraging steels
[AD-A025096] N77-11172
Fracture toughness tests on compressive preloaded specimens with a thickness of 5 mm — in crack presence
[FOK-R-1839] N77-11448
Fracture toughness of 8mm 2024-T3 non clad plate with long central cracks
[FOK-R-1879] N77-11449
FREDHOLM EQUATIONS
Numerical solution of two-dimensional integral equations using linear elements
[AD-A023693] N77-11772
FREQUENCY CONTROL
Frequency domain solution of the optimum steady-state regulator problem
[OUEL-1145/76] N77-11756
FREQUENCY SHIFT
The laser-dual-focus flow velocimeter N77-11241
The use of rotating radial diffraction gratings in laser Doppler velocimetry N77-11242
A three-component laser-Doppler-velocimeter N77-11248
Pulse NMR in solids: Chemical shift, lead fluoride and thorium hydride N77-11873
FREQUENCY STABILITY
The acoustic monopole in motion
[NASA-TM-X-73985] N77-11816
FRICTION REDUCTION
Factors contributing to low friction between wheels and road surface
[VTI-52] N77-11919
FROST
Frost insulating materials in roads
[VTI-40] N77-11917
FROST DAMAGE
Frost insulating materials in roads
[VTI-40] N77-11917
FUEL CELLS
Evaluation of potassium titanate as a component of alkaline fuel cell matrices
[NASA-TN-D-8341] N77-11175
Development of fuel cell CO detection instruments for use in a mine atmosphere
[PB-254823/8] N77-11380
Solid Polymer Electrolyte [SPE] fuel cell technology, program review, phase 2
[NASA-CR-150957] N77-11532
FUEL COMBUSTION
Ignition, combustion, detonation and quenching of reactive mixtures
[AD-A024343] N77-11060
FUEL CONSUMPTION
Optimizing the use of materials and energy in transportation construction
[PB-253713/2] N77-11475
Societal implications of energy scarcity. Social and technological priorities in steady state and constricting systems
[PB-253097/0] N77-11556
Energy use in the contract construction industry
[PB-245422/1] N77-11557
Energy use in the contract construction industry. Appendix A: Study methodology
[PB-245423/9] N77-11558
Energy use in the contract construction industry. Appendix B: Assessment of construction equipment availability, energy requirements, and construction industry capacity to support Project Independence
[PB-245424/7] N77-11559
An evaluation of high altitude engine modification devices [econo-kit]
[PB-255556/3] N77-11589
FUEL CORROSION
High energy composite double base solid propellants N77-11189
FUEL INJECTION
Bosch technical instruction. Gasoline injection D and L-jetronic
[NASA-TT-F-17111] N77-11399
FUEL TANKS
Design and development of a 28 foot tank, elastomeric coated fabric, collapsible, petroleum from a woven tube cloth
[AD-A025595] N77-11182
An evaluation of a fuel-soluble organoboron biocide for control of sulfate-reducing bacteria in shipboard fuel tanks
[AD-A024017] N77-11643
FUEL-AIR RATIO
Performance and emission characteristics of swirl-can combustors to near-stoichiometric fuel-air ratio
[NASA-TN-D-8342] N77-11056
FUELS
Study of the feasibility of federal procurement of fuels produced from solid wastes
[PB-255695/9] N77-11513
FUNCTIONAL ANALYSIS
System design of functional memory based processors N77-11691
FUNCTIONS [MATHEMATICS]
An algorithm for synthesis of combinational logic using decomposition and probability N77-11706
A FORTRAN computer program for calculating the linear prolate functions
[AD-A025210] N77-11742
Optimal order reduction N77-11745
Approximation and interpolation by inner functions N77-11761
Piecewise polynomial functions
[UCID-17059] N77-11767
On semiuniform weakly inverse semigroups and semiuniform inverse semigroups N77-11799
FUSELAGES
Catapult launch fatigue investigation of the model S-2 E airplane
[AD-A024071] N77-11038

G

GADOLINIUM
Static magnetic properties of DC biased RF sputtered GdFe amorphous films N77-11871
Electrical transport properties of itinerant and localized electron magnetic systems N77-11878
GALACTIC CLUSTERS
The relationship between the galactic matter distribution, cosmic ray dynamics, and gamma ray production
[NASA-TM-X-71224] N77-11965
GALACTIC EVOLUTION
Studies of galactic structure: The formation of galactic nuclei, the evolution of satellite galaxies, and the stability of bars N77-11943
GALACTIC NUCLEI
Studies of galactic structure: The formation of galactic nuclei, the evolution of satellite galaxies, and the stability of bars N77-11943
Measurement of the low-energy gamma radiation from the galactic center region N77-11959
GALACTIC RADIATION
Radiative transfer and gas dynamics in galactic X-ray sources N77-11957
Measurement of the low-energy gamma radiation from the galactic center region N77-11959
Observation of the galactic hard X-ray background from the OSO-7 satellite N77-11963
GALACTIC STRUCTURE
Studies of galactic structure: The formation of galactic nuclei, the evolution of satellite galaxies, and the stability of bars N77-11943
GALLIUM ARSENIDES
Manufacturing methods and technology engineering high efficiency high power gallium arsenide read-type IMPATT diodes
[AD-A023913] N77-11309
The detection capabilities of gallium arsenide and s-20 photo-multiplier tubes to go-type, point-source, signals
[AD-A023818] N77-11314
Far-infrared recombination radiation from impact-ionized shallow donors in n-type GaAs in high magnetic fields N77-11880
GALLIUM COMPOUNDS
Ionic conductivity in the sodium gallates N77-11872
GALVANOMETERS
An analysis of inertial seismometer-galvanometer combinations
[PB-254475/7] N77-11379
On the theory of the electromagnetic seismograph -- - parametrization for earth movement magnification
[KNMI-102-95] N77-11619
GAME THEORY
Stochastic multistage linear differential game with decision-time constraints N77-11784
GAMMA RAYS
Considerations to achieve directionality for gamma ray lasers
[NASA-TM-X-73580] N77-11389
Linear polarization measurements on gamma rays from Pd-100, Pd-102, Pd-104 and Pd-106 N77-11958
Measurement of the low-energy gamma radiation from the galactic center region N77-11959
The relationship between the galactic matter distribution, cosmic ray dynamics, and gamma ray production
[NASA-TM-X-71224] N77-11965
GAS ANALYSIS
A spiral sequential sampler for air and liquids, preliminary results
[PB-255435/0] N77-11386
Technical manual for measurement of fugitive emissions: Upwind/downwind sampling method for industrial emissions
[PB-253092/1] N77-11585
Sulfur dioxide interference in the measurement of ambient particulate sulfates, volume 2
[PB-254427/8] N77-11607
GAS COMPOSITION
Remote sensing of temperature and composition of gas plumes by infrared emission interferometry-spectroscopy N77-11135
Composition and equation of state of thermally dissociated matter and mass and stability of rigidly rotating relativistic polytropes N77-11843
GAS DENSITY
Maxwell yields Boltzmann t yields infinity N77-11331
GAS DETECTORS
Development of fuel cell CO detection instruments for use in a mine atmosphere
[PB-254823/8] N77-11380
GAS DYNAMICS
Current problems of optical interferometry used in experimental gas dynamics N77-11244
Radiative transfer and gas dynamics in galactic X-ray sources N77-11957
GAS FLOW
Surface cleaning by glow discharge in high volume gas flow
[AD-A024225] N77-11219
Laser Raman diagnostics of aerodynamic flows and flames N77-11234
Local measurement and proportional density of gaseous flow by Raman anti-Stokes coherent scattering N77-11235
The permeation of gases through polyethylene membranes at high pressures. A free-volume model of permeation N77-11323
Data acquisition and processing system for spectral analysis of the temporal velocity variations in a gas flow — using laser anemometry
[ISL-R-127/75] N77-11373
GAS GENERATORS
Evaluation of a spacecraft nitrogen generator
[NASA-CR-137930] N77-11672
GAS IONIZATION
Optical and laser-interferometric investigations of an electron-beam-controlled CO2-laser
[ISL-35/74] N77-11392
GAS MIXTURES
Velocity limitations in coaxial plasma gun experiments with gas mixtures
[TRITA-EPP-76-02] N77-11865
GAS POCKETS
Morphostructural methods of studying the tectronics of enclosed platforms, petroleum-gas-bearing regions
[NASA-TT-F-16734] N77-11615
GAS TEMPERATURE
Remote sensing of temperature and composition of gas plumes by infrared emission interferometry-spectroscopy N77-11135

GAS TURBINE ENGINES
Ceramic materials and components for small automotive gas turbine engine
[AD-A025472] N77-11417
GAS TURBINES
High temperature thermocouple system for advanced aircraft turbine engines
[AD-A025500] N77-11062
Reduction of gaseous pollutant emissions from gas turbine combustors using hydrogen-enriched jet fuel
[NASA-CR-149146] N77-11198
An assessment of flow quality requirements for the compressor research facility
[AD-A023888] N77-11408
Performance analysis of split-turbine concepts based on LM-2500 gas turbine components
[AD-A024058] N77-11409
A study of the factors affecting deposition characteristics of synthetic lubricants for gas turbine engines
[AD-A024472] N77-11410
Cyclic structural analysis of air-cooled gas turbine blades and vanes
[NASA-TM-X-73494] N77-11439
GASEOUS FUELS
Global measurements of gaseous and aerosol trace species in the upper troposphere and lower stratosphere from daily flights of 747 airliners
[NASA-TM-X-73544] N77-11612
GASES
Occurence of gas hydrates in the nucleü of comets
[NASA-TT-F-16740] N77-11937
GASOLINE
Development studies on conversion of methanol and related oxygenates to gasoline
[FE-1773-14] N77-11202
GEARS
Isothermal elastohydrodynamic lubrication of point contacts. III: Fully flooded results
[NASA-TN-D-8317] N77-11400
GENERAL AVIATION AIRCRAFT
Landing practices of general aviation pilots in single-engine light airplanes
[NASA-TN-D-8283] N77-11033
GENERATORS
Random bit generator
[AD-A024019] N77-11748
GENETICS
Major gene analysis: An alternative approach to the study of the genetics of human behavior
N77-11665
GEOGRAPHIC APPLICATIONS PROGRAM
Resource and environmental surveys from space with the thematic mapper in the 1980's
[NASA-CR-149191] N77-11508
GEOLOGICAL FAULTS
Use of satellite pictures for determining major shield fractures relevant for ore prospecting, northern Finland
[E77-10027] N77-11490
GEOLOGY
ERTS-B applications to Minnesota resource management
[E77-10005] N77-11485
The 29950 Earth Resource Technology Satellite [ERTS-A] sensor data for mineral resource sector development and regional land use survey, March - August 1976 — Bolivia
[E77-10028] N77-11491
LANDSAT 2 image studies as applied to a test area in northern Appennine Range
[E77-10030] N77-11493
Thematic mapping, land use, geological structure and water resources in central Spain — north of Madrid
[E77-10034] N77-11495
Investigation of long scope for highway engineering purposes
[E77-10037] N77-11498
Geological and environmental resources investigations in Egypt using LANDSAT images
[E77-10039] N77-11499
GEOMAGNETIC TAIL
Observations of plasma in the geomagnetic tail at lunar distances
N77-11961
GEOMAGNETISM
Earth magnetism, the aurora and ultralow-frequency radiation
[NASA-TT-F-16737] N77-11616
Geomagnetic effects: A rapporteur paper
[AD-A023720] N77-11620
Conditional probabilities of the geomagnetic index A sub p
[AD-A023675] N77-11626
GEOMETRY
MATCH package for the ANL three-view geometry program
[ANL/HEP/PR-76-11] N77-11719
GEOMORPHOLOGY
The 29950 Earth Resource Technology Satellite [ERTS-A] sensor data for mineral resource sector development and regional land use survey, March - August 1976 — Bolivia
[E77-10028] N77-11491
LANDSAT 2 image studies as applied to a test area in northern Appennine Range
[E77-10030] N77-11493
Morphostructural methods of studying the tectronics of enclosed platforms, petroleum-gas-bearing regions
[NASA-TT-F-16734] N77-11615
GEOPHYSICS
Gravity geophysics for groundwater exploration in glaciated areas
[PB-254542/4] N77-11510
Morphostructural methods of studying the tectronics of enclosed platforms, petroleum-gas-bearing regions
[NASA-TT-F-16734] N77-11615
Earth and ocean modeling
[NASA-CR-150055] N77-11617
GLASS
Preparation and properties of beta-alumina/glass composites
[PB-255549/8] N77-11130
Energy transfer between inorganic ions in glasses
[AD-A023910] N77-11141
GLASS FIBER REINFORCED PLASTICS
Mechanical properties of glass and Kevlar molded composites
[AD-A024196] N77-11126
GLASS FIBERS
Certification of the replacement of glass fabric per mat. spec. 5.670/1, with glass fabric per mat. spec. 5.670 in the F27 plastic sandwich wing-and-stabilizer-leading edges — noting shear strength and sandwich stiffness
[FOK-R-1876] N77-11122
GLOW DISCHARGES
Surface cleaning by glow discharge in high volume gas flow
[AD-A024225] N77-11219
GOGGLES
Reduction of target detectability by laser protective materials
[AD-A024383] N77-11682
GOLD
Electron impact ionization cross sections of gold, chromium and iron
[AD-A024208] N77-11834
GOVERNMENT PROCUREMENT
A conceptual model for evaluating contractor management during source selection
[AD-A023817] N77-11896
GOVERNMENTS
Federal scientific and technical communication activities: 1975
[PB-253975/7] N77-11279
GRAIN BOUNDARIES
Grain boundary structures and energies in fcc-iron
[HEDL-SA-1002] N77-11884
GRAMMARS
A verification system for JOVIAL/J3 programs [Rugged Programming Environment: RPE/1]
[AD-A024395] N77-11730
GRANULAR MATERIALS
Interstellar space: The astrochemist's laboratory
N77-11941
GRAPH THEORY
Data structures: Specification and realization
[AD-A024396] N77-11698
Special cases of the quadratic assignment problem
[AD-A025605] N77-11740
GRAPHITE
Development of a graphite horizontal stabilizer
[AD-A023767] N77-11036
Investigation of stress levels causing significant damage in composites
[AD-A024537] N77-11127
GRAPHS [CHARTS]
Graph information retrieval language: Programming manual for FORTRAN complement, revision 1
[AD-A025292] N77-11735
Critical cutsets of graphs and canonical facets of set packing polytopes
[AD-A023854] N77-11806
GRATINGS [SPECTRA]
The laser-dual-focus flow velocimeter
N77-11241
The use of rotating radial diffraction gratings in laser Doppler velocimetry
N77-11242
Periodic integrated optical structures in photoresist: Application to grating couplers
N77-11847
GRAVIMETERS
Gravity geophysics for groundwater exploration in glaciated areas
[PB-254542/4] N77-11510
GRAVITATION
Studies in gravitation
N77-11610
GRAVITATIONAL CONSTANT
A new method for measuring the Newtonian gravitational constant, G
N77-11807
GRAVITATIONAL FIELDS
Homogeneous cosmologies with strong neutrino fields
N77-11844
GRAVITY GRADIOMETERS
A new method for measuring the Newtonian gravitational constant, G
N77-11807
GRAVITY WAVES
Mathematical models of acoustic and acoustic-gravity wave propagation in fluids with height-dependent sound velocities
N77-11813
GREASES
Lubrication of bearings in vacuum. Examination of life-tested bearings from MSDS Ltd — lead and grease lubricants
[T[F]S/128] N77-11407
GRINDING [MATERIAL REMOVAL]
Bearing restoration by grinding
[NASA-CR-149188] N77-11404
GROUND STATE
The ground state electronic structure of atomic boron
N77-11827
GROUND SUPPORT EQUIPMENT
Aircraft ground fire suppression and rescue systems. Characteristics of kinematic jet fuel fires cascading and rod fuel geometries
[AD-A024447] N77-11022
GROUND TESTS
Ground test of the D shaped vented thrust vectoring nozzle
[NASA-CR-137959] N77-11107
GROUND TRUTH
Investigations using data from LANDSAT-2 — Bangladesh
[E77-10029] N77-11492
Development of remote sensing technology in New Zealand, part 1. Seismotectonic, structural, volcanologic and geomorphic study of New Zealand, part 2. Indigenous forest assessment, part 3. Mapping land use and environmental studies in New Zealand, Part 4. New Zealand forest service LANDSAT projects, part 5. Geographical applications in LANDSAT mapping: Landuse mapping and environmental studies, part 6
[E77-10040] N77-11500
GROUND WATER
Geological and environmental resources investigations in Egypt using LANDSAT images
[E77-10039] N77-11499
Retransmission of hydrometric data in Canada
[E77-10041] N77-11501
Gravity geophysics for groundwater exploration in glaciated areas
[PB-254542/4] N77-11510
Optimal management of the subsurface environment: Parameter identification
[PB-255648/8] N77-11921
GROUND-AIR-GROUND COMMUNICATIONS
Study of the use of Cefly Lancer wideband data link equipment for Guardrail 2A, 4, and 5.
[AD-A025089] N77-11280
GROUP THEORY
On semiuniform weakly inverse semigroups and semiuniform inverse semigroups
N77-11799
Almost completely decomposable groups
N77-11801
Compact transitive isometry groups
N77-11802
A study of resonating group theory and alpha-helium elastic scattering
N77-11839
GUIDE VANES
Performance and boundary-layer evaluation of a sonic inlet
[NASA-TN-D-8340] N77-11004
GUINEA PIGS
Influence of the peak pressure and duration of impulse noise [gun fire] on the hearing of the guinea pig
[ISL-R-109/75] N77-11639
Influence of a precursor noise on the global action potential consecutive to an impulse noise in the Guinea pig
[ISL-R-115/75] N77-11640
GULF OF MEXICO
LANDSAT menhaden and thread herring resources investigation, Gulf of Mexico
[E77-10036] N77-11497
GUN PROPELLANTS
New methods for the measurement of relative ignitability and ignition efficiency
[AD-A023862] N77-11206
GYROSCOPES
Feasibility study of performing system calibration in an operate mode
[AD-A024744] N77-11026

H

HADRONS
Zeros of the multiparticle generating function in hadronic scattering models
N77-11825

HAFNIUM
The oxidation of T-111 alloy at high termperatures and low pressures
N77-11145

HANDBOOKS
Total energy management: A practical handbook on energy conservation and management
[PB-254683/6] N77-11554

HARDENING [MATERIALS]
Advanced hardened antenna window materials study 4
[AD-A023944] N77-11128
Synthesis of new superhard materials and their application to cutting tools
[AD-A024342] N77-11166
The influences of retarding admixtures on volume changes of concrete
[PB-254929/3] N77-11477

HARDWARE
Final approach performance monitor
[AD-A028513/0] N77-11024

HARMONIC GENERATIONS
Second harmonic generation in a bounded magnetoplasma
N77-11860

HARTREE APPROXIMATION
Hartree-Fock energy curves, for BrH[+][X[P2]I], KrH[+][X1 sigma [+]], and RbH[+][X 2 sigma [+]]
[UCRL-51738] N77-11831

HCL LASERS
Efficient high-energy HCl chemical laser
[AD-A023787] N77-11393

HEAT EXCHANGERS
Low temperature heat exchangers
[BMFT-FB-T-76-07] N77-11350

HEAT FLUX
The measurement of igniter heat flux in solid propellant rocket motors
N77-11192
Hydrodynamic aspects of the critical heat flux in subcooled convection boiling
N77-11329
A general formulation and some approximate methods for multi-dimensional nongray radiative transfer
N77-11338

HEAT PIPES
Test program for transmitter experiment package and heat pipe system for the communications technology satellite
[NASA-TM-X-3455] N77-11268
Investigation of performance limits in axial groove heat pipes
[NASA-CR-137912] N77-11340

HEAT PUMPS
Commercial building unitary heat pump system with solar heating
[PB-255488/9] N77-11551

HEAT RESISTANT ALLOYS
Effect of microstructure on the fatigue crack growth of a powder metallurgy nickel-base superalloy
N77-11153
Refinement of promising coating compositions for directionally cast eutectics
[NASA-CR-135103] N77-11154
Utilization and limitations of phase transformations and microstructures in alloy design for strength and toughness
[LBL-4175] N77-11157
Directionally solidified in situ metal matrix composites, part 1 — superalloys for manufacture of turbine blades
[AD-A024217] N77-11162
Development of directionally solidified eutectic nickel and cobalt alloys — for turbine blades
[AD-A024420] N77-11165
Synthesis of new superhard materials and their application to cutting tools
[AD-A024342] N77-11166

HEAT SOURCES
Shape analysis of pulsed second sound in superfluid helium
N77-11210
Ultrasonic examination of thin iridium hemispheres for the multihundred watt heat source
[MLM-2291] N77-11419

HEAT TRANSFER
Heat-transfer distributions on a 0.013-scale shuttle solid rocket booster at Mach 3.70 and angles of attack from 0 deg to 180 deg
[NASA-TM-X-3417] N77-10995
Design study of steady-state 30-tesla liquid-neon-cooled magnet
[NASA-TN-D-8337] N77-11213
An experimental and analytical study of the sputtering phenomena
N77-11336
A device for rapid determination of thermophysical properties of phase-change wind-tunnel models
[NASA-TM-X-3421] N77-11346

HEAT TREATMENT
Heat treatment of refuse for increasing anaerobic biodegradability
[PB-252924/6] N77-11577

HEATING EQUIPMENT
The Chicago Project: Evaluation and testing of three types of energy audit processes for school buildings
[PB-255321/2] N77-11555
Nonstationary analysis of ohmic and viscous heating of a cylindrical plasma shell
[TRITA-EPP-75-19] N77-11864

HEAVY ELEMENTS
Hartree-Fock energy curves, for BrH[+][X[P2]I], KrH[+][X1 sigma [+]], and RbH[+][X 2 sigma [+]]
[UCRL-51738] N77-11831

HEAVY IONS
High spin states in Mg-26 and Na-23 populated by heavy ion reactions
N77-11838

HELICAL WINDINGS
Shot peening procedures for helical compression springs
[AD-A023758] N77-11415

HELICOPTER PERFORMANCE
Army preliminary evaluation YOH-58A helicopter with a flat-plate canopy
[AD-A024501] N77-11039
Helicopter reliability growth evaluation
[AD-A025265] N77-11041

HELICOPTERS
Helicopter yaw axis augmentation investigation
[AD-A024512] N77-11066

HELIUM
A study of resonating group theory and alpha-helium elastic scattering
N77-11839
Plane shock waves in quantum gases at very low temperatures
N77-11867

HELIUM ISOTOPES
Plane shock waves in quantum gases at very low temperatures
N77-11867

HEMISPHERICAL SHELLS
Ultrasonic examination of thin iridium hemispheres for the multihundred watt heat source
[MLM-2291] N77-11419

HEMORRHAGES
Ventricular pathology in swine at high sustained +G sub z
N77-11646

HF LASERS
Experimental studies of a continuous-wave HF[DF] confocal unstable resonator
[AD-A025268] N77-11395
Time variations of HF induced plasma waves
N77-11611

HIGH ACCELERATION
Influence of aircraft angle of attack on high G cockpit design
[AD-A025083] N77-11043

HIGH ALTITUDE ENVIRONMENTS
The mass spectrum of charged cosmic rays at mountain altitudes
N77-11962

HIGH ENERGY ELECTRONS
Transformation of high energy electrons to muons in the Coulomb field of a nucleus
N77-11841

HIGH ENERGY FUELS
High energy composite double base solid propellants
N77-11189

HIGH ENERGY INTERACTIONS
The renormalisation group and scaling at high energy in Yukawa field theory
N77-11842

HIGH FREQUENCIES
Manufacturing methods and technology engineering high efficiency high power gallium arsenide read-type IMPATT diodes
[AD-A023913] N77-11309

HIGH PRESSURE
Development of high pressure devices and high pressure syntheses
[BMFT-FB-76-19] N77-11177

HIGH RESOLUTION
Application of hypervelocity backward reference holography to the study of dynamic deformations
[ISL-R-135/75] N77-11375

HIGH SPEED
The Langley thermal protection system test facility: A description including design operating boundaries
[NASA-TM-X-73973] N77-11067

HIGH STRENGTH ALLOYS
Utilization and limitations of phase transformations and microstructures in alloy design for strength and toughness
[LBL-4175] N77-11157
Synthesis of new superhard materials and their application to cutting tools
[AD-A024342] N77-11166

HIGH STRENGTH STEELS
Errors observed in quantitative ion microprobe analysis
[PB-252400/7] N77-11378

HIGH TEMPERATURE
The oxidation of T-111 alloy at high termperatures and low pressures
N77-11145
Basic mechanisms providing oxidation resistance in structural metals at high temperatures. Volume 2: The defect structure of nonstoiometric rutile [Ti O2] and nonstoichiometric rutile containing 1 to 10 mole percent Cb205
[AD-A024540] N77-11161

HIGH TEMPERATURE AIR
Thermal boundary layer flow of absorbing and emitting high temperature air
N77-11333

HIGH TEMPERATURE ENVIRONMENTS
Development of electronic circuits for advanced high temperature fire detectors
[AD-A023843] N77-11318

HIGH TEMPERATURE GASES
Asphalt hot-mix emission study
[PB-250504/8] N77-11542

HIGH TEMPERATURE RESEARCH
Development of high pressure devices and high pressure syntheses
[BMFT-FB-76-19] N77-11177

HIGH VOLTAGES
Development of new active semiconductor surface passivation technologies for high blocking voltage power devices — thyristors
[BMFT-FB-T-76-15] N77-11304

HIGHWAYS
Highway insulating material evaluation
[PB-254792/5] N77-11466
Technology for using sulfate waste in highway construction
[PB-254815/4] N77-11468
The influences of retarding admixtures on volume changes of concrete
[PB-254929/3] N77-11477
Investigation of long scope for highway engineering purposes
[E77-10037] N77-11498
Measurement and prediction of sound attenuation by highway barriers using acoustic modeling techniques
N77-11812

HILBERT SPACE
Inverse source problem: Eigenfunction analysis of Bojarski's integral equation
[AD-A025297] N77-11776

HOLOGRAMMETRY
The effects of optimal path pertubations during recording on a reconstructed holographic image
N77-11361

HOLOGRAPHIC INTERFEROMETRY
Interferometry of transient phenomena using lasers emitting at different wavelengths in the UV, visible, and infrared spectral range
[ISL-36/74] N77-11368
Application of hypervelocity backward reference holography to the study of dynamic deformations
[ISL-R-135/75] N77-11375
Optical and laser-interferometric investigations of an electron-beam-controlled CO2-laser
[ISL-35/74] N77-11392

HOLOGRAPHY
Holographic flow visualization — of aircraft wakes
[NASA-CR-149182] N77-11365
Some properties of sources used in hypervelocity holography — coherent light sources
[ISL-CO-217/75] N77-11369
Polychromatic light holography
[ISL-R-124/75] N77-11372

HOMOMORPHISMS
Characterization theorem for topological semilattices on the two-cell
N77-11803

HOT-WIRE ANEMOMETERS
The measurement of spatial vorticity distributions using hot-wire anemometry techniques
[AD-A024161] N77-11014
Comparison of instantaneous velocity measurements by hot-wire anemometry and laser anemometry — in cold free jet flow
[ISL-R-117/75] N77-11371

HOVERCRAFT GROUND EFFECT MACHINES
The operation of hovercraft in New York City metropolitan area. Volume 2: Economic feasibility
[PB-251235/8] N77-11021

HOVERING
Influence of pilot incapacitation on low speed and hovering flight
[AD-A023728] N77-11684

HUMAN BEHAVIOR
Major gene analysis: An alternative approach to the study of the genetics of human behavior
N77-11665

HUMAN BEINGS
Space is for man
[NASA-TT-F-16254] N77-11075
HUMAN CENTRIFUGES
The pathophysiology of high sustained +G sub z acceleration, limitation to air combat manoeuvering and the use of centrifuges in performance training
[AGARD-CP-189] N77-11644
Centrifuge assessment of a reclining seat
N77-11648
Utilization of human centrifuge for training military pilots in the execution of protective straining maneuvers
N77-11651
The use of a fixed base simulator as a training device for high sustained or ACM [Air Combat Maneuvering] +G sub z stress
N77-11652
HUMAN FACTORS ENGINEERING
Paths of movement for selected body segments during typical pilot tasks
[AD-A025773] N77-11520
The effect of pre-adapting spectral stimuli on visual response
[AD-A024312] N77-11659
An experimental study for determining human discomfort response to roll vibration
[NASA-TN-D-8266] N77-11666
Dynamic contrast requirements --- relationship between human visual system and displayed imagery
[AD-A023973] N77-11683
Comparison of human information processing performance with DOT and stroke alphabetic characters
[AD-A024099] N77-11686
Enhancement of human effectiveness in system design, training, and operation: July 1974 - June 1975
[AD-A023941] N77-11687
Urban design and usage factors of paratransit vehicles and facilities
[PB-255541/5] N77-11929
HUMAN PERFORMANCE
An application of Wiener analysis to human visual psychophysical response
N77-11669
Target detection in rapidly-changing visual sequences
[AD-A023784] N77-11685
HUMAN REACTIONS
S2 probability and CNV [Contingent Negative Variation] --- signal detection task and selective reaction time task
[IZF-1975-11] N77-11668
Application of principles of organizational structure to high technology activities
[AD-A024012] N77-11895
HUMAN RESOURCES
Management auditing
[AD-A024133] N77-11899
HUMAN TOLERANCES
Psycho-physiological and physio-chemical assessment of acceleration induced changes in humans positioned in various seatback angle configurations
N77-11647
HYDRATES
Occurence of gas hydrates in the nucleii of comets
[NASA-TT-F-16740] N77-11937
HYDRAULIC EQUIPMENT
Design and performance of the four-degrees-of-freedom motion system of the NLR research flight simulator
[NLR-MP-75038-U] N77-11072
HYDRAZINES
Propellant material compatibility program and results
[NASA-CR-149149] N77-11197
HYDROCARBONS
Measurements of energy losses, distributions of energy loss and additivity of energy losses for 50 to 150 KeV protons in hydrogen and nine hydrocarbon gases
N77-11823
HYDRODYNAMIC EQUATIONS
Hydrodynamic aspects of the critical heat flux in subcooled convection boiling
N77-11329
Brownian motion of interacting particles
N77-11824
HYDRODYNAMICS
A theoretical prediction technique for lateral hydrodynamic loads on sidewalks of surface-effects ships
[AD-A024510] N77-11220
A hydrodynamic stability analysis of some proposed model equations for biofluids
N77-11322
Optimum step design for centering of pistons moving in an incompressible fluid
[NASA-TN-D-8345] N77-11402
Thermochemical water splitting: The reverse Deacon reaction and alternatives
[IS-M-63] N77-11541
HYDROELECTRIC POWER STATIONS
Multi-year time frame optimization of power systems with fossil, nuclear, hydro, pumped storage and peaking units
N77-11525
HYDROGEN
Electrolytic hydrogen in beta titanium
N77-11146
Measurements of energy losses, distributions of energy loss and additivity of energy losses for 50 to 150 KeV protons in hydrogen and nine hydrocarbon gases
N77-11823
The thermodynamics and kinetics of interstitial solid solutions
N77-11883
HYDROGEN CHLORIDES
Comment on A paradox: The thermal rate coefficient for the H + DCl yields HCl + D exchange reaction
[AD-A023896] N77-11139
HYDROGEN EMBRITTLEMENT
Diffusion in transition metals and alloys and selective adsorption and hydrogen embrittlement
N77-11144
Studies of the kinetics of environmental hydrogen embrittlement in titanium alloys
N77-11151
Susceptibility of cold-worked zirconium-2.5 wt. percent niobium alloy to delayed hydrogen cracking
[AECL-5260] N77-11156
HYDROGEN OXYGEN ENGINES
Hydrogen-fueled engine
[NASA-CASE-NPO-13763-1] N77-11398
HYDROGEN-BASED ENERGY
Metalhydrides
[OUEL-1146/76] N77-11158
Hydrogen for energy storage: A progress report of technical developments and possible applications
[BNL-20931] N77-11201
HYDROGEOLOGY
Gravity geophysics for groundwater exploration in glaciated areas
[PB-254542/4] N77-11510
HYDROLOGY
The LANDSAT satellite and flood control in New England, June 1976
[E77-10026] N77-11489
Investigation of long scope for highway engineering purposes
[E77-10037] N77-11498
Retransmission of hydrometric data in Canada
[E77-10041] N77-11501
Technical manual for estimating low-flow frequency characteristics of streams in the Susquehanna River basin
[PB-255455/8] N77-11512
HYDROSTATIC PRESSURE
Nonaxisymmetric incompressible hydrostatic pressure effects in radial face seals
[NASA-TN-D-8343] N77-11401
HYGROSCOPICITY
Water vapor in the lower stratosphere measured from aircraft flight
[NASA-TM-X-71220] N77-11618
HYPERBOLIC FUNCTIONS
Finite-difference approximations and entropy conditions for shocks
[COO-3077-106] N77-11764
HYPERSONIC FLOW
The electron beam fluorescence technique applied to hypersonic turbulent flows
N77-11236
Resonant Doppler velocimeter
N77-11239
HYPERSONIC WIND TUNNELS
Mach 4 free-jet tunnel starting experiments for a hypersonic research engine model causing high blockage
[NASA-TM-X-3418] N77-11069
HYPERVELOCITY IMPACT
Application of hypervelocity backward reference holography to the study of dynamic deformations
[ISL-R-135/75] N77-11375
HYPERVELOCITY PROJECTILES
Behavior of steel fragments on thin Duralumin targets. Oblique incidence. Multiple targets
[ISL-R-112/75] N77-11406

I

I BEAMS
Hardboard-webbed I-beams subjected to short-term loading
[AD-A024507] N77-11465
ICE NUCLEI
Occurence of gas hydrates in the nucleii of comets
[NASA-TT-F-16740] N77-11937
IDEAL GAS
Maxwell yields Boltzmann t yields infinity
N77-11331
IDENTIFYING
The multivariable identification package for a PDP-11 computer: User guide
[OUEL-1142/76] N77-11725
IGNITION
Ignition, combustion, detonation and quenching of reactive mixtures
[AD-A024343] N77-11060
IGNITION TEMPERATURE
New methods for the measurement of relative ignitability and ignition efficiency
[AD-A023862] N77-11206
ILLINOIS
Economic impact study of the proposed motor vehicle [in-use] noise regulations
[PB-255686/8] N77-11583
The air quality and economic implications of supplementary control systems in Illinois --- considering electric power plant fuels
[PB-255699/1] N77-11588
IMAGE CONTRAST
Dynamic contrast requirements --- relationship between human visual system and displayed imagery
[AD-A023973] N77-11683
IMAGE ENHANCEMENT
Photon limited images and their restoration
[AD-A024027] N77-11700
IMAGE TUBES
New storage tubes
[BMFT-FB-T-76-02] N77-11298
Evaluation of a large format image tube camera for the shuttle sortie mission
[NASA-CR-149093] N77-11362
IMAGERY
Dynamic contrast requirements --- relationship between human visual system and displayed imagery
[AD-A023973] N77-11683
IMAGING TECHNIQUES
The effects of optimal path pertubations during recording on a reconstructed holographic image
N77-11361
IMPACT RESISTANCE
Effect of fiber diameter and matrix alloys on impact-resistant boron/aluminum composites
[NASA-TN-D-8204] N77-11118
IMPLANTED ELECTRODES [BIOLOGY]
The development of chronic insertable oxygen electrodes
[AD-A024633] N77-11657
Investigation of the medical applications of the unique biocarbons developed by NASA
[NASA-CR-150061] N77-11916
IMPURITIES
Techniques for modeling multidimensional effects in integrated devices
N77-11292
IN-FLIGHT MONITORING
Airborne LIDAR Raps studies, February 1974 --- for computerized air pollution monitoring
[PB-255886/4] N77-11601
INCOMPRESSIBILITY
Nonaxisymmetric incompressible hydrostatic pressure effects in radial face seals
[NASA-TN-D-8343] N77-11401
INCOMPRESSIBLE BOUNDARY LAYER
An ALGOL program for the calculation of incompressible three dimensional turbulent boundary layers
[NLR-TR-74159-U] N77-11010
INCOMPRESSIBLE FLUIDS
Optimum step design for centering of pistons moving in an incompressible fluid
[NASA-TN-D-8345] N77-11402
INDEPENDENT VARIABLES
Multi-parametric mathematical programming problems
[AD-A025715] N77-11741
Conditionally effective evaluations of the parameters of nonlinear models
[NASA-TT-F-17264] N77-11785
INDEXES [DOCUMENTATION]
ADINDEX: A PL/1 program that produces simple or structured indexes from ADSEP data bases
[ORNL-CSD-TM-1] N77-11720
Technical guidelines for public water systems
[PB-255217/2] N77-11928
INDEXES [RATIOS]
Conditional probabilities of the geomagnetic index A sub p
[AD-A023675] N77-11626
INDIUM ALLOYS
Investigation of electronic transport, recombination and optical properties in In As sub 1-x P sub x alloy systems
[AD-A025294] N77-11889
INDIUM ANTIMONIDES
Thermal conductivity of heavily doped p-type indium antimonide
N77-11876
INDUSTRIAL ENERGY
Energy use in the contract construction industry
[PB-245422/1] N77-11557
INDUSTRIAL PLANTS
Asphalt hot-mix emission study
[PB-250504/8] N77-11542

Air pollution monitoring at the Redcar site: Measurement of grit and dust [3d]
[PB-254199/3] N77-11579

INDUSTRIAL WASTES
Technology for using sulfate waste in highway construction
[PB-254815/4] N77-11468
Technical manual for measurement of fugitive emissions: Upwind/downwind sampling method for industrial emissions
[PB-253092/1] N77-11585
Characterization and evaluation of wastewater sources United States Steel Corporation, Homestead wheel and axle plant, McKees Rocks, Pennsylvania, August 21-28, 1975
[PB-255593/6] N77-11586
Characterization and evaluation of wastewater sources United States Steel Corporation, Duquesne plant, Pittsburgh, Pennsylvania, February 26 - March 6, 1976
[PB-255594/4] N77-11587
Evaluation of Rexnord gravel bed filter
[PB-255095/2] N77-11597

INDUSTRIES
Industrial thermal insulation: An assessment
[ORNL-TM-5283] N77-11534
User's guide to petroleum industry survey data type
[PB-256635/4] N77-11544
Energy use in the contract construction industry. Appendix A: Study methodology
[PB-245423/9] N77-11558
Energy use in the contract construction industry. Appendix B: Assessment of construction equipment availability, energy requirements, and construction industry capacity to support Project Independence
[PB-245424/7] N77-11559

INERTIAL NAVIGATION
Feasibility study of performing system calibration in an operate mode
[AD-A024744] N77-11026

INERTIAL PLATFORMS
An analysis of inertial seismometer-galvanometer combinations
[PB-254475/7] N77-11379

INFORMATION MANAGEMENT
Energy information activities at the FEA
[PB-253962/5] N77-11553
Man, design, machine: An inquiry into principles of normative planning for computer-based technical systems illustrated by a case design of an entry, storage and retrieval system for scientific communication and technology tranfer
N77-11743
Information sciences: Information processing systems and techniques. Bibliography, Apr. 1958 - Nov. 1975
[AD-A024600] N77-11902

INFORMATION RETRIEVAL
Critical equipment list information retrieval
[AD-A025070] N77-11701
Graph information retrieval language: Programming manual for FORTRAN complement, revision 1
[AD-A025292] N77-11735
Man, design, machine: An inquiry into principles of normative planning for computer-based technical systems illustrated by a case design of an entry, storage and retrieval system for scientific communication and technology tranfer
N77-11743

INFORMATION SYSTEMS
Detailed design specification for the ALT Shuttle Information Extraction Subsystem [SIES]
[NASA-CR-151097] N77-11091
Federal scientific and technical communication activities: 1975
[PB-253975/7] N77-11279
A systematic approach to operational scheduling for information collection systems
N77-11483
Energy information activities at the FEA
[PB-253962/5] N77-11553
Computer graphics applications in transportation information systems
[PB-254795/8] N77-11696
The evaluation of integrated market research information systems for new product decisions
N77-11900
Information sciences: Information processing systems and techniques. Bibliography, Apr. 1958 - Nov. 1975
[AD-A024600] N77-11902
Evaluation of the feasibility of an independent HSA data base relative to proposed HSA budgets and staffing
[PB-254920/2] N77-11903
DAISY: An applications perspective
[AD-A023875] N77-11904
Data storage decisions for large data bases
[AD-A023874] N77-11905

INFRARED DETECTORS
Development of electronic circuits for advanced high temperature fire detectors
[AD-A023843] N77-11318
Charge coupled scanned IR imaging sensors
[AD-A025224] N77-11858

INFRARED INTERFEROMETERS
Remote sensing of temperature and composition of gas plumes by infrared emission interferometry-spectroscopy
N77-11135
Current problems of optical interferometry used in experimental gas dynamics
N77-11244

INFRARED RADIATION
Infrared signature modifications, volume 1
[AD-A024653] N77-11854

INFRARED RADIOMETERS
Study of a Vuilleumier cycle cryogenic refrigerator for detector cooling on the limb scanning infrared radiometer
[NASA-CR-145078] N77-11211
The Apollo 17 infrared scanning radiometer
N77-11950

INFRARED SCANNERS
Charge coupled scanned IR imaging sensors
[AD-A025224] N77-11858
The Apollo 17 infrared scanning radiometer
N77-11950

INFRARED SPECTRA
Compilation of stratospheric trace gas spectral parameters
[AD-A025490] N77-11632
Infrared signature modifications, volume 1
[AD-A024653] N77-11854

INFRARED SPECTROMETERS
Observations of Jupiter with a Hadamard transform spectrometer
[AD-A025273] N77-11939

INFRARED SPECTROSCOPY
Observations of Jupiter with a Hadamard transform spectrometer
[AD-A025273] N77-11939

INHOMOGENEITY
A limit on the inhomogeneity of the cosmic microwave background radiation at an angular scale of 1.25 arcmin
N77-11964

INPUT/OUTPUT ROUTINES
System identification techniques using the group method of data handling
N77-11713
Utility programs for the UNIVAC 9300 system at the MCL computer facility
[PB-255891/4] N77-11739
Parallel multitonic sorting networks
[AD-A024392] N77-11749

INSTRUMENT LANDING SYSTEMS
Final approach performance monitor
[AD-A028513/0] N77-11024

INSTRUMENT PACKAGES
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 2: Scientific objectives and passive sounder instruments
[ESA-CR[P]-836-VOL-2] N77-11088
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 3: Accommodation of instruments and packages on Spacelab
[ESA-CR[P]-836-VOL-3] N77-11089

INTEGRAL EQUATIONS
The finite integral method applied to some problems of structural mechanics
N77-11423
Inverse source problem: Eigenfunction analysis of Bojarski's integral equation
[AD-A025297] N77-11776

INTEGRAL TRANSFORMATIONS
Fourier integral methods for static and dynamic problems in microstrip
N77-11293

INTEGRATED CIRCUITS
Techniques for modeling multidimensional effects in integrated devices
N77-11292
Thin film circuits for future applications. Part 2: Evaporation technique
[BMFT-FB-T-76-21] N77-11307
Top collector contacted microwave power transistor; monolithic microwave lumped element integrated circuit program, phase I
[AD-A023829] N77-11313

INTERATOMIC FORCES
Implications of alloy structure with respect to mechanical properties
[AD-A023832] N77-11164

INTERIOR BALLISTICS
An interior ballistics model for a spinning rocket motor
N77-11193
Lagrange coordinate interior ballistic calculation model
[ISL-CO-215/75] N77-11205

INTERMODULATION
Intermodulation study
[AD-A023906] N77-11308

INTERNAL COMBUSTION ENGINES
Hydrogen-fueled engine
[NASA-CASE-NPO-13763-1] N77-11398

INTERNATIONAL COOPERATION
Report to AID on a Phillipines survey on standardization and measurement services
[PB-255803/9] N77-11216

INTERPLANETARY MAGNETIC FIELDS
Comment on 'Kp dependence on sectors, by I. B. McDiarmid and E. E. Budzinski
[NASA-CR-149176] N77-11624
Radio observations of interplanetary magnetic field structures out of the ecliptic
[NASA-TM-X-71223] N77-11947
Interplanetary sector structure 1947 - 1975
[NASA-CR-149175] N77-11948

INTERPLANETARY MEDIUM
A quasi-linear kinetic equation for cosmic rays in the interplanetary medium
[AD-A023849] N77-11966

INTERPLANETARY SPACE
Interplanetary sector structure 1947 - 1975
[NASA-CR-149175] N77-11948

INTERPOLATION
First-Order-hold interpolation digital-to-analog converter with application to aircraft simulation
[NASA-TN-D-8331] N77-11693
Approximation and interpolation by inner functions
N77-11761

INTERSTELLAR EXTINCTION
Neutrino astrophysics
[NASA-TT-F-17249] N77-11946

INTERSTELLAR SPACE
Interstellar space: The astrochemist's laboratory
N77-11941

INVARIANCE
Covariance-invariant discrete-time systems
[AD-A024273] N77-11757

INVARIANT IMBEDDINGS
An invariant imbedding, orders-of-scattering approach to particle transport in a slab
[AD-A024155] N77-11832

ION BEAMS
Potential biomedical applications of ion beam technology
[NASA-TM-X-73512] N77-11655

ION CYCLOTRON RADIATION
Nonlinear ion motion in the slow ion cyclotron
N77-11840

ION DISTRIBUTION
A study of electromigration in microwave power transistors
N77-11290

ION EMISSION
A theory of ion sputtering --- from metals and semimetals
N77-11143

ION IMPACT
Far-infrared recombination radiation from impact-ionized shallow donors in n-type GaAs in high magnetic fields
N77-11880

ION MOTION
Nonlinear ion motion in the slow ion cyclotron
N77-11840

ION PROBES
Errors observed in quantitative ion microprobe analysis
[PB-252400/7] N77-11378

ION PROPULSION
Compensated control loops for a 30-cm ion thruster
[NASA-TM-X-73497] N77-11100
Long lifetime hollow cathodes for 30-cm mercury ion thrusters
[NASA-TM-X-73523] N77-11101
Cycle life testing of 8-cm mercury ion thruster cathodes
[NASA-TM-X-73526] N77-11102
Performance documentation of the engineering model 30-cm diameter thruster
[NASA-TM-X-73530] N77-11103
Sputtering phenomena of discharge chamber components in a 30-cm diameter Hg ion thruster
[NASA-TM-X-73533] N77-11104
High reliability cathode heaters for ion thrusters
[NASA-TM-X-73538] N77-11105
Electron bombardment propulsion system characteristics for large space systems
[NASA-TM-X-73554] N77-11106

ION RECOMBINATION
Calculation of energetics of selected atmospheric systems. Theoretical study of dissociative-recombination of e + NO[+]
[AD-A024309] N77-11629

IONIC CRYSTALS
A classical theory of the dielectric susceptibility of anharmonic crystals
N77-11874

IONIZATION
Collisional ionization of xenon atoms in well defined high Rydberg states
N77-11826

IONIZATION CROSS SECTIONS
Tabulation of hybrid theory calculated e-N2 vibrational and rotational cross sections
[NASA-TN-D-8347] N77-11830
Electron impact ionization cross sections of gold, chromium and iron
[AD-A024208] N77-11834

IONOSPHERIC DISTURBANCES
The construction of storm-time corrections for ionospheric F-region parameters and their application to trans-ionospheric group-path delay
[AD-A024408] N77-11621
IONOSPHERIC HEATING
Time variations of HF induced plasma waves
N77-11611
IONOSPHERIC PROPAGATION
Numerical representation of monthly median critical frequencies of the regular E region [foE]
[PB-253484/8] N77-11276
IONS
Sensors for continuous monitoring of toxic ions, nutrients, and dissolved gases in water
[PB-254834/5] N77-11387
IRIDIUM
Ultrasonic examination of thin iridium hemispheres for the multihundred watt heat source
[MLM-2291] N77-11419
IRON
Embrittlement of carbon steels and iron by indium
N77-11149
On the kinetics and thermodynamics of metallic solid solutions
N77-11150
Spectral reflectance signatures of coastal pollutants — Delaware
[E77-10011] N77-11486
Electron impact ionization cross sections of gold, chromium and iron
[AD-A024208] N77-11834
Static magnetic properties of DC biased RF sputtered GdFe amorphous films
N77-11871
Grain boundary structures and energies in fcc-iron
[HEDL-SA-1002] N77-11884
IRON ALLOYS
Directionally solidified in situ metal matrix composites, part 1 — superalloys for manufacture of turbine blades
[AD-A024217] N77-11162
Chemical breakdown of passivity
[PB-255102/4] N77-11169
Ellipsometric spectroscopic study of breakdown of Fe-Cr and Fe-Cr-Mo alloys
[PB-255203/2] N77-11170
ISLANDS
Investigations using data from LANDSAT-2 — Bangladesh
[E77-10029] N77-11492
Development of remote sensing technology in New Zealand, part 1. Seismotectonic, structural, volcanologic and geomorphic study of New Zealand, part 2. Indigenous forest assessment, part 3. Mapping land use and environmental studies in New Zealand, Part 4. New Zealand forest service LANDSAT projects, part 5. Geographical applications in LANDSAT mapping: Landuse mapping and environmental studies, part 6
[E77-10040] N77-11500
ISRAEL
The nuclear power plant: Preview of its implications regarding the electricity grid
[INIS-MF-1868] N77-11566
ITALY
LANDSAT 2 image studies as applied to a test area in northern Appennine Range
[E77-10030] N77-11493
ITERATION
Iterated codes with improved performance
N77-11704
Iterative forward-adjoint Monte Carlo solutions of the Boltzmann transport equation
N77-11783

J

J-85 ENGINE
Effects of forward velocity on noise for a J85 turbojet engine with multitube suppressor from wind tunnel and flight tests
[NASA-TM-X-73542] N77-11051
JACKS [LIFTS]
Design and performance of the four-degrees-of-freedom motion system of the NLR research flight simulator
[NLR-MP-75038-U] N77-11072
JAPAN
Investigation of environmental change pattern in Japan
[E77-10025] N77-11488
JET ENGINE FUELS
Aircraft ground fire suppression and rescue systems. Characteristics of kinematic jet fuel fires cascading and rod fuel geometries
[AD-A024447] N77-11022
JET EXHAUST
Density measurement of copper shaped charge jet using the flash radiography — using equivalence of optical density and thickness in X ray absorption
[ISL-R-101/76] N77-11376
JET FLOW
Effects of jets, wakes, and vortices on lifting surfaces
[NASA-TM-X-73974] N77-10998
Characterization of noise sources in hot jets by the crossed beam technique
N77-11238
Experimental investigation of coaxial turbulent jets
N77-11337
JET PROPULSION
Project SQUID: A cooperative program of fundamental research related to jet propulsion
[AD-A024004] N77-11059
JOINTS [JUNCTIONS]
Significance of measured local strains for the fatigue strength of joints
[LBF-FB-128/76] N77-11446
Rigid pavement joints and sealants study
[PB-254806/3] N77-11469
JUNCTION DIODES
New methods for improving the stability of power diodes
[BMFT-FB-T-76-09] N77-11300
Destruction by avalanche burnout — power diodes, noting IMPATT effect
[BMFT-FB-T-76-14] N77-11303
JUNCTION TRANSISTORS
Top collector contacted microwave power transistor; monolithic microwave lumped element integrated circuit program, phase 1
[AD-A023829] N77-11313
JUPITER [PLANET]
Observations of Jupiter with a Hadamard transform spectrometer
[AD-A025273] N77-11939

K

KALMAN FILTERS
Covariance-invariant discrete-time systems
[AD-A024273] N77-11757
KINEMATIC EQUATIONS
Analysis of the perturbed motion of asymmetric, spinning spacecraft
[NLR-TR-75043-U] N77-11097
KINETIC THEORY
On renormalized kinetic theories of anomalous transport due to hydrodynamic fluctuations in strongly magnetized plasma
N77-11862
KINETICS
Studies of the kinetics of environmental hydrogen embrittlement in titanium alloys
N77-11151
Calculation of energetics of selected atmospheric systems. Theoretical study of dissociative-recombination of e + NO[+]
[AD-A024309] N77-11629
KNUDSEN FLOW
The Knudsen flow between oblique plates
[REPT-1/1976] N77-11347
KP INDEX
Comment on 'Kp dependence on sectors, by I. B. McDiarmid and E. E. Budzinski
[NASA-CR-149176] N77-11624
KRYPTON
Hartree-Fock energy curves, for BrH[+][X[P2]I], KrH[+][X1 sigma [+]], and RbH[+][X 2 sigma [+]]
[UCRL-51738] N77-11831

L

LAGRANGE COORDINATES
Lagrange coordinate interior ballistic calculation model
[ISL-CO-215/75] N77-11205
LAGRANGE MULTIPLIERS
Nonlinear optimization and generalized Lagrange multipliers
[AD-A024413] N77-11793
LAKES
ERTS-B applications to Minnesota resource management
[E77-10005] N77-11485
LAMINAR BOUNDARY LAYER
The effects of wall temperature and suction on laminar boundary-layer stability
[AD-A025337] N77-11355
LAMINAR FLOW
Thermal boundary layer flow of absorbing and emitting high temperature air
N77-11333
LAMINATES
Nonlinear analysis of laminated fibrous composites
N77-11113
Lamination residual stresses in hybrid composites, part 1
[NASA-CR-135085] N77-11114
Wave propagation in fiber composite laminates, part 2
[NASA-CR-135086] N77-11115
Crack growth data of 2024-T3-clad as determined in Fokker report R-1764 and in NLR report TN-M2092 — noting crack growth rates in specimens tested in fatigue
[FOK-R-1814] N77-11120
Corrosion behaviour of mixed laminates [CFRP core with both 7075-T6 clad and 5052-H38 faces]
[FOK-R-1868] N77-11121
LAND USE
ERTS-B applications to Minnesota resource management
[E77-10005] N77-11485
The 29950 Earth Resource Technology Satellite [ERTS-A] sensor data for mineral resource sector development and regional land use survey, March - August 1976 — Bolivia
[E77-10028] N77-11491
Investigations using data from LANDSAT-2 — Bangladesh
[E77-10029] N77-11492
Thematic mapping, land use, geological structure and water resources in central Spain — north of Madrid
[E77-10034] N77-11495
Investigation of long scope for highway engineering purposes
[E77-10037] N77-11498
Development of remote sensing technology in New Zealand, part 1. Seismotectonic, structural, volcanologic and geomorphic study of New Zealand, part 2. Indigenous forest assessment, part 3. Mapping land use and environmental studies in New Zealand, Part 4. New Zealand forest service LANDSAT projects, part 5. Geographical applications in LANDSAT mapping: Landuse mapping and environmental studies, part 6
[E77-10040] N77-11500
Draft environmental assessment of application by ERDA for a special land use permit for use of public lands in Wyoming for in situ coal gasification experiments
[UCID-17011] N77-11572
Selected priorities: 1978-82. A first-year effort recommending priorities for selected Federal water and related land resource programs in New England
[PB-255890/6] N77-11600
LANDING GEAR
Fatigue investigation of the E-2B/C nose landing gear
[AD-A024072] N77-11040
LANDSAT SATELLITES
LANDSAT 2: Cumulative Non-US Standard Catalog, 1975 - 1976 — LANDSAT imagery for January 1975 through January 1976
[NASA-TM-X-74212] N77-11481
LANDSAT 2: Cumulative US Standard Catalog, 1975 - 1976 — LANDSAT imagery for January 1975 through January 1976
[NASA-TM-X-74217] N77-11482
LANDSAT: Non-US Standard Catalog, 1 - 30 June 1976 — LANDSAT imagery for June 1976
[GSFC/LN-76/006] N77-11504
The ten-ecosystem study investigation plan
[NASA-CR-151099] N77-11505
LANDSAT: US Standard Catalog, 1 - 31 July 1976 -- - LANDSAT imagery for July, 1976
[NASA-TM-X-74213] N77-11507
LANDSAT: Non-US Standard Catalog — LANDSAT imagery for July 1976
[NASA-TM-X-74214] N77-11521
LANDSAT: Non-US Standard Catalog — LANDSAT imagery for August 1976
[NASA-TM-X-74215] N77-11522
LANDSAT: US Standard catalog — LANDSAT imagery for August 1976
[NASA-TM-X-74216] N77-11523
LANDSAT 1
LANDSAT: US Standard Catalog, 1 - 30 June 1976
[NASA-TM-X-74219] N77-11506
LANDSAT 2
LANDSAT: US Standard Catalog, 1 - 30 June 1976
[NASA-TM-X-74219] N77-11506
LANGUAGE PROGRAMMING
Research on a high level language approach to operating system design
[AD-A023866] N77-11733
LAPLACE TRANSFORMATION
Numerical solution of two-dimensional integral equations using linear elements
[AD-A023693] N77-11772
LASER APPLICATIONS
Laser induced fluorescence as a spectroscopic tool
N77-11131
Comment on A paradox: The thermal rate coefficient for the H + DCl yields HCl + D exchange reaction
[AD-A023896] N77-11139
Review on high speed applications of laser anemometry in France and Germany
N77-11222
Laser velocimetry applied to transonic and supersonic aerodynamics
N77-11224
Application of the dual-scatter laser velocimeter in transonic flow research
N77-11225

The application of a laser anemometer to the investigation of shock-wave boundary-layer interactions
N77-11226
Laser Raman diagnostics of aerodynamic flows and flames
N77-11234
Qualitative and quantitative flow field visualization utilizing laser-induced fluorescence
N77-11237
The time-of-flight laser anemometer
N77-11243
Flow field in the wake of a blunt body by laser Doppler anemometry
N77-11245
Investigation of a V-gutter stabilized flame by laser anemometry and schlieren photography
N77-11246
Simultaneous laser measurements of instantaneous velocity and concentration in turbulent mixing flows
N77-11247
Comparison of laser anemometry methods of several laboratories. Report on ISL measurements carried out 5 - 8 November 1974 --- two-focus and Doppler anemometry
[ISL-R-129/75] N77-11374
Further development of a method for measuring velocity and length by laser technology
[BMFT-FB-T-76-17] N77-11377
Laser applications in flight control --- and optoelectronics applications
N77-11391
Optical surface waveguide discontinuities
N77-11852
A study of X-ray emission from laser heated plasma
[AD-A025498] N77-11866

LASER DOPPLER VELOCIMETERS
Applications of non-intrusive instrumentation in fluid flow research --- including Raman spectra, Laser Doppler Velocimeters, and electron beams; conference proceedings
[AGARD-CP-193] N77-11221
Applications of the laser Doppler velocimeter to measure subsonic and supersonic flows
N77-11223
Laser velocimetry applied to transonic and supersonic aerodynamics
N77-11224
Application of the dual-scatter laser velocimeter in transonic flow research
N77-11225
Supersonic velocity and turbulence measurements using a Fabry-Perot interferometer
N77-11227
Recent applications of ISL of the laser velocimeter measurements in turbulent flows
N77-11228
Analysis of the ouput data of a laser Doppler velocimeter
N77-11229
Single scattering particle laser Doppler measurements of turbulence
N77-11230
Measurement of periodic flows using laser Doppler correlation techniques
N77-11232
Resonant Doppler velocimeter
N77-11239
Fringe mode fluorescence velocimetry
N77-11240
The laser-dual-focus flow velocimeter
N77-11241
The use of rotating radial diffraction gratings in laser Doppler velocimetry
N77-11242
A three-component laser-Doppler-velocimeter
N77-11248
Experimental investigation of coaxial turbulent jets
N77-11337
New applications of laser anemometry to turbulent flow
[ISL-CO-212/75] N77-11349
Laser anemometry and displacement of the measurement point in industrial wind tunnels --- in France
[ISL-R-116/75] N77-11370
Comparison of instantaneous velocity measurements by hot-wire anemometry and laser anemometry --- in cold free jet flow
[ISL-R-117/75] N77-11371
Data acquisition and processing system for spectral analysis of the temporal velocity variations in a gas flow --- using laser anemometry
[ISL-R-127/75] N77-11373
Comparison of laser anemometry methods of several laboratories. Report on ISL measurements carried out 5 - 8 November 1974 --- two-focus and Doppler anemometry
[ISL-R-129/75] N77-11374
Further development of a method for measuring velocity and length by laser technology
[BMFT-FB-T-76-17] N77-11377
Investigating complex aerodynamic flows with a laser velocimeter
[NASA-TM-X-73171] N77-11390

LASER MATERIALS
Energy transfer between inorganic ions in glasses
[AD-A023910] N77-11141

LASER MODES
Mode properties in unstable optical resonators
N77-11850

LASER OUTPUTS
Interferometry of transient phenomena using lasers emitting at different wavelengths in the UV, visible, and infrared spectral range
[ISL-36/74] N77-11368

LASERS
Considerations to achieve directionality for gamma ray lasers
[NASA-TM-X-73580] N77-11389
Laser scanning of MOS IC's reveals internal logic states nondestructively
[PB-252798/4] N77-11394

LATTICE VIBRATIONS
Interstellar space: The astrochemist's laboratory
N77-11941

LATTICES [MATHEMATICS]
Characterization theorem for topological semilattices on the two-cell
N77-11803

LAW [JURISPRUDENCE]
Noise Control Act extension
[GPO-52-021] N77-11910

LEAD [METAL]
Lubrication of bearings in vacuum. Examination of life-tested bearings from MSDS Ltd --- lead and grease lubricants
[T[F]S/128] N77-11407

LEARNING MACHINES
Speculation on the evolution of intelligence and its possible realization in machine form
N77-11752
Knowledge acquisition from structural descriptions
[AD-A025074] N77-11759

LEAST SQUARES METHOD
The least squares collocation from the adjustment point of view and related topics
[AD-A024203] N77-11628
Some iterative procedures to obtain nonlinear least squares estimates
[AD-A024437] N77-11768

LENGTH
Further development of a method for measuring velocity and length by laser technology
[BMFT-FB-T-76-17] N77-11377

LIBRARIES
A technological review: The future of microimagery in the library
[PB-255725/4] N77-11906

LIE GROUPS
On the exponential map of a Lie group
N77-11805

LIFE [DURABILITY]
A second look at relationships for estimating peacetime aircraft attrition
[AD-A023681] N77-11023
A study of electromigration in microwave power transistors
N77-11290

LIFT FANS
Performance of 1.15-pressure-ratio fan stage at several rotor blade setting angles with reverse flow
[NASA-TM-X-3451] N77-11008
Preliminary design-lift/cruise fan research and technology airplane flight control system
[NASA-CR-137971] N77-11064

LIFTING BODIES
Effects of jets, wakes, and vortices on lifting surfaces
[NASA-TM-X-73974] N77-10998

LIGANDS
Thermodynamic study of metal ion-macrocyclic ligand interaction
N77-11890

LIGHT AIRCRAFT
Study of small turbofan engines applicable to single-engine light airplanes
[NASA-CR-137944] N77-11054

LIGHT SCATTERING
Analysis of the data from the three-dimensional gradient study --- for atmospheric pollutant layers diffusion
[PB-253936/9] N77-11578

LIGHT SCATTERING METERS
Rayleigh linewidth measurements in liquid helium
N77-11209
Scanning radiometer for measurement of forward-scattered light to determine mean diameter of spray particles
[NASA-TM-X-3454] N77-11366

LIGHT SOURCES
Some properties of sources used in hypervelocity holography --- coherent light sources
[ISL-CO-217/75] N77-11369

LIGHTNING
Radiation from a current filament driven by a traveling wave
[NASA-TN-D-8302] N77-11294

LINEAR EQUATIONS
Optimal linear coding for a multichannel system
N77-11251

LINEAR FILTERS
Response of linear discrete systems to modulated sequences
N77-11258
The design of filters to have linear passband phase and arbitrary stopband loss
N77-11288

LINEAR PROGRAMMING
Optimal linear coding for a multichannel system
N77-11251
Multi-parametric mathematical programming problems
[AD-A025715] N77-11741

LINEAR SYSTEMS
A FORTRAN computer program for calculating the linear prolate functions
[AD-A025210] N77-11742
Optimal order reduction
N77-11745
The stabilization of bilinear systems and its application to the discrete model reference adaptive control
N77-11754
Control by model error estimation
[NASA-CR-150059] N77-11755

LIQUID COOLING
Development and fabrication of an advanced liquid cooling garment
[NASA-CR-137974] N77-11673

LIQUID HELIUM
Rayleigh linewidth measurements in liquid helium
N77-11209

LIQUID HELIUM 2
Shape analysis of pulsed second sound in superfluid helium
N77-11210

LIQUID METALS
KKR analysis of the Anderson-McMillan theory of electronic structure of liquid metals
[AD-A024386] N77-11887

LIQUID NEON
Design study of steady-state 30-tesla liquid-neon-cooled magnet
[NASA-TN-D-8337] N77-11213

LITHOGRAPHY
Photolithographic techniques for Surface Acoustic Wave [SAW] devices
[AD-A025492] N77-11822
A high performance, low cost, digitally driven electron beam lithography system
N77-11846

LOAD TESTS
Influence of mica on the compaction and bearing properties of base course aggregate
[VTI-55] N77-11920

LOADING RATE
Simple determination of the mechanical behavior of double base rocket propellants under high loading rates
N77-11195
Mechanism of material fatigue during the crack initiation stage
[ICAF-DOC-895] N77-11441

LOADS [FORCES]
Influence of aircraft angle of attack on high G cockpit design
[AD-A025083] N77-11043
A theoretical prediction technique for lateral hydrodynamic loads on sidewalks of surface-effects ships
[AD-A024510] N77-11220
Added mass and damping forces on circular cylinders
[AD-A024037] N77-11353
Transient analysis of a three-dimensional elastic plate by the Ray grouping technique
N77-11433
Hardboard-webbed I-beams subjected to short-term loading
[AD-A024507] N77-11465

LOGARITHMS
On the logarithms of high order spacings
[AD-A023716] N77-11770

LOGICAL ELEMENTS
ROM programmable cellular array
N77-11289

LONGITUDINAL STABILITY
Calculation of the longitudinal aerodynamic characteristics of wing-flap configurations with externally blown flaps
[NASA-CR-2705] N77-11006

LOOP ANTENNAS
The infinitely long Yagi array of concentric circular loops
N77-11253

LOW PRESSURE
The oxidation of T-111 alloy at high termperatures and low pressures
N77-11145

LOW TEMPERATURE
Effect of oxygen-catalyzed nuclear spin conversion on the low temperature heat capacity of methane
[LBL-4149] N77-11203
Low temperature heat exchangers
[BMFT-FB-T-76-07] N77-11350

Plane shock waves in quantum gases at very low temperatures N77-11867

LUBRICANTS
An analysis of data taken from the impact viscometer at Imperial College [AD-A023143] N77-11178
A study of the factors affecting deposition characteristics of synthetic lubricants for gas turbine engines [AD-A024472] N77-11410

LUBRICATION
Isothermal elastohydrodynamic lubrication of point contacts. III: Fully flooded results [NASA-TN-D-8317] N77-11400
Computer analysis of the performance of a swing-pad bearing with a compliant pad surface [AD-A024418] N77-11414

LUNAR ATMOSPHERES
The lunar exosphere N77-11949

LUNAR ORBITS
Observations of plasma in the geomagnetic tail at lunar distances N77-11961

LUNAR SURFACE
The Apollo 17 infrared scanning radiometer N77-11950

M

MACH NUMBER
Mach 4 free-jet tunnel starting experiments for a hypersonic research engine model causing high blockage [NASA-TM-X-3418] N77-11069

MACHINE TOOLS
Synthesis of new superhard materials and their application to cutting tools [AD-A024342] N77-11166

MACHINERY
Dynamics of inertia variant machinery N77-11809

MACROSCOPIC EQUATIONS
Macroscopic study of time unsteady noise of an aircraft engine during static tests [NASA-TM-X-73556] N77-11052

MAGNESIUM ISOTOPES
High spin states in Mg-26 and Na-23 populated by heavy ion reactions N77-11838

MAGNETIC COILS
Design study of steady-state 30-tesla liquid-neon-cooled magnet [NASA-TN-D-8337] N77-11213

MAGNETIC DIPOLES
Orbital motion of dipoles in electromagnetic fields N77-11330

MAGNETIC FIELDS
An experimental and theoretical study of the propagation of high amplitude pulses in a bounded magneto-plasma N77-11861
Field effect in ferromagnetic metals N77-11881
Escape of charged particles from a neutron star N77-11934

MAGNETIC MATERIALS
Critical points in magnetic systems, a neutron diffraction study of CsCoCl32D2O [RCN-235] N77-11885

MAGNETIC PROPERTIES
Static magnetic properties of DC biased RF sputtered GdFe amorphous films N77-11871

MAGNETIC RESONANCE
Radio-frequency wave coupling and mode conversion at the lower hybrid resonance N77-11249

MAGNETIC STORMS
The construction of storm-time corrections for ionospheric F-region parameters and their application to trans-ionospheric group-path delay [AD-A024408] N77-11621

MAGNETIC TAPES
Antenna prediction computer problems [AD-A024552] N77-11734

MAGNETOHYDRODYNAMIC FLOW
Two dimensional MHD duct flow: Numerical analysis and measurements [NLR-MP-75016-U] N77-11348
On renormalized kinetic theories of anomalous transport due to hydrodynamic fluctuations in strongly magnetized plasma N77-11862

MAGNETOSPHERE
Observations at the planet Mercury by the plasma electron experiment, Mariner 10 [NASA-TM-X-71210] N77-11944

MAGNETOSTRICTION
Magnetoelastic interactions in SmCo5 N77-11810

MAGNIFICATION
On the theory of the electromagnetic seismograph -- - parametrization for earth movement magnification [KNMI-102-95] N77-11619

MAGNUS EFFECT
An improved projectile boattail, part 2 [AD-A024073] N77-11016

MAINTENANCE
Improvement of Utah's flexible pavement performance system [PB-254819/6] N77-11462

MAMMALS
Principles of biodynamics. Volume 3: Physiological mechanisms in the mammal underlying posture, locomotion, and orientation in space [AD-A023691] N77-11661

MAN MACHINE SYSTEMS
A model for predicting integrated man-machine system reliability. 2: Model validation [AD-A023886] N77-11420
Paths of movement for selected body segments during typical pilot tasks [AD-A025773] N77-11520
Continuing research in the development of interactive man-computer systems for engineering-construction projects [PB-252927/9] N77-11679
Enhancement of human effectiveness in system design, training, and operation: July 1974 - June 1975 [AD-A023941] N77-11687
SAINT II documentation manual [AD-A024286] N77-11689

MANAGEMENT METHODS
Optimizing the use of materials and energy in transportation construction [PB-253713/2] N77-11475

MANAGEMENT PLANNING
A systematic approach to operational scheduling for information collection systems N77-11483
Multi-year time frame optimization of power systems with fossil, nuclear, hydro, pumped storage and peaking units N77-11525
Justifications of appropriation estimates for Committee on Appropriations, fiscal year 1976 [PB-256464/9] N77-11604
Application of principles of organizational structure to high technology activities [AD-A024012] N77-11895
Program Evaluation and Review Technique [PERT]: A planning and control tool for occupational field studies --- training and reference material for new personnel and project directors [AD-A024131] N77-11897
Management auditing [AD-A024133] N77-11899
Optimal productivity for solid waste collection: A systems approach N77-11913
Planning and programming for transportation [PB-255637/1] N77-11925

MANGANESE OXIDES
High temperature thermocouple system for advanced aircraft turbine engines [AD-A025500] N77-11062

MANIFOLDS [MATHEMATICS]
Torsion and the geometry of spin N77-11808

MANNED SPACE FLIGHT
Space launches and finishes [NASA-TT-F-17278] N77-11076

MANUFACTURING
The optimal planning of computerized manufacturing systems [PB-252887/5] N77-11215

MAPPING
Computer program projecting fictitious longitude and latitude systems onto standard Mercator grids [AD-A025076] N77-11517
Applying computer-drawn maps of geologic data to analysis of mining problems [PB-255497/0] N77-11518
The Apollo 17 infrared scanning radiometer N77-11950

MAPS
On the exponential map of a Lie group N77-11805

MARAGING STEELS
Development of high fracture toughness in maraging steels [AD-A025096] N77-11172

MARINE PROPULSION
Performance analysis of split-turbine concepts based on LM-2500 gas turbine components [AD-A024058] N77-11409

MARINE RESOURCES
LANDSAT menhaden and thread herring resources investigation, Gulf of Mexico [E77-10036] N77-11497

MARINE TRANSPORTATION
The operation of hovercraft in New York City metropolitan area. Volume 2: Economic feasibility [PB-251235/8] N77-11021

MARINER 10 SPACE PROBE
Observations at the planet Mercury by the plasma electron experiment, Mariner 10 [NASA-TM-X-71210] N77-11944

MARKET RESEARCH
The evaluation of integrated market research information systems for new product decisions N77-11900

MARKOV PROCESSES
Large-scale programming in Markov decision processes N77-11712
Partially observable Markov decision processes over an infinite planning horizon with discounting [AD-A025077] N77-11778
A class of network decomposition switches [AD-A024325] N77-11797

MARTENSITE
Strain energy criterion of martensitic transformation [AD-A023781] N77-11163

MASONRY
Structural performance of masonry walls under compression and flexure [PB-255075/4] N77-11459

MASS FLOW
Added mass and damping forces on circular cylinders [AD-A024037] N77-11353

MASS SPECTRA
The mass spectrum of charged cosmic rays at mountain altitudes N77-11962

MASS TRANSFER
Mathematical modelling for an unsteady vertically stratified flow field N77-11335

MATERIALS
Industrial thermal insulation: An assessment [ORNL-TM-5283] N77-11534

MATERIALS HANDLING
Propellant material compatibility program and results [NASA-CR-149149] N77-11197

MATERIALS RECOVERY
Steel from urban waste [PB-255441/8] N77-11167

MATHEMATICAL LOGIC
Characterization theorem for topological semilattices on the two-cell N77-11803

MATHEMATICAL MODELS
The establishment of safe separations between aircraft in flight [NLR-MP-75041-U] N77-11020
A second look at relationships for estimating peacetime aircraft attrition [AD-A023681] N77-11023
The effect of finite test section length on wall interference in 2-D ventilated wind tunnels [NLR-MP-75036-U] N77-11071
Dynamics of the continuous settling of discrete-particle slurries N77-11134
Chemical breakdown of passivity [PB-255102/4] N77-11169
Analysis of economics of a TV broadcasting satellite for additional nationwide TV programs [BMFT-FB-T-76-05] N77-11270
Antenna mathematical modeling [GTD] [AD-A025259] N77-11282
Mathematical modelling for an unsteady vertically stratified flow field N77-11335
Development of mathematical model for pneumatic tire-soil interaction in layered soils [AD-A024162] N77-11416
Wind induced vibrations of self supporting conical columns with end mass N77-11436
A systematic approach to operational scheduling for information collection systems N77-11483
Mathematics for energy [PB-252463/5] N77-11543
A new atmospheric diffusion model N77-11609
The least squares collocation from the adjustment point of view and related topics [AD-A024203] N77-11628
Predictive model of the auditory process as related to communication systems [AD-A024300] N77-11656
Photon limited images and their restoration [AD-A024027] N77-11700
Control by model error estimation [NASA-CR-150059] N77-11755
Necessary conditions for the existence of some incomplete block designs [AD-A025856] N77-11779
Scattering from large planar gratings of compliant cylindrical shells [AD-A025279] N77-11820

MATHEMATICAL PROGRAMMING
Brief instructions for using MATHLIB [version 6.0]
[SAND-75-0545] N77-11721
MATRICES [MATHEMATICS]
Explicit inverses of some special matrices [with a few computer programs]
[ORNL-CSD-2] N77-11765
Necessary conditions for the existence of some incomplete block designs
[AD-A025856] N77-11779
Experimental evaluation of an options selection matrix as an operational decision aid
[AD-A023889] N77-11893
MATRIX METHODS
Comparison of human information processing performance with DOT and stroke alphabetic characters
[AD-A024099] N77-11686
MAXIMA
Optimal order reduction
N77-11745
MAXIMUM LIKELIHOOD ESTIMATES
Application of the maximum plausibility method to the problem of determination of the intensities of an intermixed poisson flux
[NASA-TT-F-17265] N77-11786
MAXWELL FLUIDS
Theory of shock structure in a Maxwell gas based on the Chapman-Enskog development through Super-Super-Burnett order
N77-11324
MAXWELL-BOLTZMANN DENSITY FUNCTION
Maxwell yields Boltzmann t yields infinity
N77-11331
MEASURING INSTRUMENTS
Applications of non-intrusive instrumentation in fluid flow research — including Raman spectra, Laser Doppler Velocimeters, and electron beams; conference proceedings
[AGARD-CP-193] N77-11221
Air pollution monitoring at the Redcar site: Measurement of grit and dust [3d]
[PB-254199/3] N77-11579
MECHANICAL PROPERTIES
Strain rate effects on mechanical properties of fiber composites, part 3
[NASA-CR-135087] N77-11116
The effects of moisture on the mechanical performance of T300/graphite/glass/epoxy hybrid composites
[AD-A023668] N77-11124
Mechanical properties of glass and Kevlar molded composites
[AD-A024196] N77-11126
Implications of alloy structure with respect to mechanical properties
[AD-A023832] N77-11164
Simple determination of the mechanical behavior of double base rocket propellants under high loading rates
N77-11195
Effect of polymer state on the mechanical and transport behavior of polymer impregnated mortars
N77-11425
Three-dimensional finite element analysis of a large circular disc with circular penetrations
[WAPD-TM-1206] N77-11444
MEDICAL SCIENCE
Studies of thick target fast neutron production and proton activation of the stable isotope tracer Ca-48 as applications of nuclear physics in medicine
N77-11837
MERCATOR PROJECTION
Computer program projecting fictitious longitude and latitude systems onto standard Mercator grids
[AD-A025076] N77-11517
MERCURY [METAL]
Long lifetime hollow cathodes for 30-cm mercury ion thrusters
[NASA-TM-X-73523] N77-11101
Cycle life testing of 8-cm mercury ion thruster cathodes
[NASA-TM-X-73526] N77-11102
Performance documentation of the engineering model 30-cm diameter thruster
[NASA-TM-X-73530] N77-11103
Sputtering phenomena of discharge chamber components in a 30-cm diameter Hg ion thruster
[NASA-TM-X-73533] N77-11104
MERCURY [PLANET]
Observations at the planet Mercury by the plasma electron experiment, Mariner 10
[NASA-TM-X-71210] N77-11944
MESSAGES
Adaptive message switching networks
N77-11262
METABOLISM
Study of metabolic response variation to an acoustic aggression — metabolic recuperation after sonic boom N wave exposure
[ISL-R-120/75] N77-11641
METAL BONDING
Research on adhesive bonding and surface characteristics of metals at Fokker-VFW
[FOK-R-1816] N77-11405
An experimental investigation of babbitt metal bonding
[AD-A024306] N77-11413
METAL COMPOUNDS
Mechanisms of adhesion failure between polymers and metallic substrates. Part 2: Aluminum 2024-T3 and titanium 6Al4V with HT424 adhesive
[AD-A025256] N77-11183
METAL FATIGUE
Analog computation assessment of the risk of structural failure due to crack growth under random loading
[AD-A025266] N77-11042
Mechanism of material fatigue during the crack initiation stage
[ICAF-DOC-895] N77-11441
METAL HYDRIDES
Metalhydrides
[OUEL-1146/76] N77-11158
METAL IONS
Thermodynamic study of metal ion-macrocyclic ligand interaction
N77-11890
METAL MATRIX COMPOSITES
Effect of fiber diameter and matrix alloys on impact-resistant boron/aluminum composites
[NASA-TN-D-8204] N77-11118
Directionally solidified in situ metal matrix composites, part 1 — superalloys for manufacture of turbine blades
[AD-A024217] N77-11162
Evaluation of potassium titanate as a component of alkaline fuel cell matrices
[NASA-TN-D-8341] N77-11175
Study of erosion mechanisms of engineering ceramics
[AD-A025258] N77-11184
METAL OXIDE SEMICONDUCTORS
Laser scanning of MOS IC's reveals internal logic states nondestructively
[PB-252798/4] N77-11394
A photocurrent spectroscopic method for determination of trapping state distributions in silicon dioxide thin films
N77-11875
METAL PLATES
Nonlinear analyses of the stress field near a crack or hole in a plate
N77-11430
The development of steel plate for offshore structures
[PB-254195/1] N77-11453
METALS
A theory of ion sputtering — from metals and semimetals
N77-11143
Quantum size oscillations and size effects
N77-11877
KKR analysis of the Anderson-McMillan theory of electronic structure of liquid metals
[AD-A024386] N77-11887
METEOROLOGICAL PARAMETERS
Meteorological regimes for the classification of aerospace air quality predictions for NASA-Kennedy Space Center
[NASA-TM-X-3450] N77-11570
Assimilation of surface, upper air, and grid-point data in the objective analysis procedure for a three-dimensional trajectory model
[PB-256082/9] N77-11638
METHANE
Absolute rate of the reaction of C I[2P] with methane from 200-500 K
[NASA-TM-X-71221] N77-11136
Effect of oxygen-catalyzed nuclear spin conversion on the low temperature heat capacity of methane
[LBL-4149] N77-11203
Heat treatment of refuse for increasing anaerobic biodegradability
[PB-252924/6] N77-11577
METHYL ALCOHOLS
Methanol from coal fuel and other applications
[ORAU-126] N77-11200
Development studies on conversion of methanol and related oxygenates to gasoline
[FE-1773-14] N77-11202
METROLOGY
Regional seminar on a system of standardization and metrology for Latin America
[PB-254469/0] N77-11214
MEXICO
Investigation of long scope for highway engineering purposes
[E77-10037] N77-11498
MICA
Influence of mica on the compaction and bearing properties of base course aggregate
[VTI-55] N77-11920
MICROBIOLOGY
ASTP chemical and microbiological analysis of potable water
[NASA-TM-X-58192] N77-11675
MICROFILMS
A technological review: The future of microimagery in the library
[PB-255725/4] N77-11906
MICROPROCESSORS
A hierarchical restructurable multi-microprocessor architecture
N77-11692
Developmental system for microcomputer based intelligent graphics terminals
[LA-UR-76-125] N77-11694
MICROSTRIP TRANSMISSION LINES
Thin conformal antenna array for microwave power conversion
[NASA-CASE-NPO-13886-1] N77-11269
MICROSTRUCTURE
Embrittlement of carbon steels and iron by indium
N77-11149
Effect of microstructure on the fatigue crack growth of a powder metallurgy nickel-base superalloy
N77-11153
Utilization and limitations of phase transformations and microstructures in alloy design for strength and toughness
[LBL-4175] N77-11157
MICROWAVE ANTENNAS
Thin conformal antenna array for microwave power conversion
[NASA-CASE-NPO-13886-1] N77-11269
Dual band airborne antenna test program
[AD-A024024] N77-11275
MICROWAVE EMISSION
A limit on the inhomogeneity of the cosmic microwave background radiation at an angular scale of 1.25 arcmin
N77-11964
MICROWAVE EQUIPMENT
Performance of microwave diodes as detectors and mixers with respect to their device parameters
N77-11261
MICROWAVE FREQUENCIES
Top collector contacted microwave power transistor; monolithic microwave lumped element integrated circuit program, phase 1
[AD-A023829] N77-11313
MICROWAVE LANDING SYSTEMS
Flight test demonstration of selected curved-segmented approach paths based on microwave landing system guidance
[AD-A025501] N77-11028
Simulation of an automatically-controlled STOL aircraft in a microwave landing system multipath environment
[NASA-TM-X-73154] N77-11063
Airborne antenna polarization study for the microwave landing system
[NASA-TM-X-73952] N77-11266
MICROWAVE OSCILLATORS
Destruction by avalanche burnout — power diodes, noting IMPATT effect
[BMFT-FB-T-76-14] N77-11303
MICROWAVE REFLECTOMETERS
Microwave response of nonequilibrium superconductors
N77-11879
MICROWAVE TRANSMISSION
A study of electromigration in microwave power transistors
N77-11290
MICROWAVES
Advanced concepts of microwave generation and control in solids
[AD-A023950] N77-11311
MILITARY AIRCRAFT
A second look at relationships for estimating peacetime aircraft attrition
[AD-A023681] N77-11023
MILITARY HELICOPTERS
Influence of pilot incapacitation on low speed and hovering flight
[AD-A023728] N77-11684
MILITARY OPERATIONS
New propellants for tactical weapons: Silanes
N77-11190
MILITARY TECHNOLOGY
The electromagnetic pulse [EMP] — effect on military electronic equipment
[AD-A023775] N77-11277
MINERALS
The 29950 Earth Resource Technology Satellite [ERTS-A] sensor data for mineral resource sector development and regional land use survey, March - August 1976 — Bolivia
[E77-10028] N77-11491
MINES [EXCAVATIONS]
Development of fuel cell CO detection instruments for use in a mine atmosphere
[PB-254823/8] N77-11380
A spiral sequential sampler for air and liquids, preliminary results
[PB-255435/0] N77-11386
Design, development, fabrication and testing of a portable self-contained respirable dust mass monitor
[PB-254503/6] N77-11681
Determination of cosmic ray muon intensities deep underground
N77-11960

MINING
Applying computer-drawn maps of geologic data to analysis of mining problems
[PB-255497/0] N77-11518
MINNESOTA
ERTS-B applications to Minnesota resource management
[E77-10005] N77-11485
MISSILE TRAJECTORIES
Optimal multiple-arc trajectories for an all-aspect air-to-air missile
N77-11082
MISSILES
Military rocket aircraft: Inherent constraints and their uses
N77-11186
MISSION PLANNING
Space station systems analysis study. Part 1, volume 3: Appendices. Book 1: Objective data
[NASA-CR-151104] N77-11083
MISSOURI
Airborne LIDAR Raps studies, February 1974 — for computerized air pollution monitoring
[PB-255886/4] N77-11601
MIXERS
Performance of microwave diodes as detectors and mixers with respect to their device parameters
N77-11261
Low Reynolds number entrance flows: A study of a motionless mixer
N77-11319
MODELS
Discrete modeling of flow systems
N77-11320
Proceedings of the Workshop on Modeling the Interrelationships between the Energy Sector and the General Economy
[PB-255696/7] N77-11561
Conditionally effective evaluations of the parameters of nonlinear models
[NASA-TT-F-17264] N77-11785
MOISTURE
The effects of moisture on the mechanical performance of T300/graphite/glass/epoxy hybrid composites
[AD-A023668] N77-11124
MOLDS
Mechanical properties of glass and Kevlar molded composites
[AD-A024196] N77-11126
MOLECULAR BIOLOGY
Aqueous artefacts: The riddle of bound water
[AD-A024643] N77-11663
MOLECULAR ENERGY LEVELS
Electronic angular momentum transfer in the I[doublet P[1/2]] + NF [a singlet delta] system
[AD-A024258] N77-11833
Molecular clusters and catalytic activity
[AD-A024349] N77-11888
MOLECULAR EXCITATION
Efficient high-energy HCl chemical laser
[AD-A023787] N77-11393
MOLECULAR ROTATION
Tabulation of hybrid theory calculated e-N2 vibrational and rotational cross sections
[NASA-TN-D-8347] N77-11830
MOLECULAR SPECTRA
Compilation of stratospheric trace gas spectral parameters
[AD-A025490] N77-11632
MOLECULAR STRUCTURE
Structure-property relationships bibenzoxazole polymers containing fluorocarbon linkages
[AD-A023822] N77-11180
Aqueous artefacts: The riddle of bound water
[AD-A024643] N77-11663
MOLYBDENUM
Ellipsometric spectroscopic study of breakdown of Fe-Cr and Fe-Cr-Mo alloys
[PB-255203/2] N77-11170
MOMENTS OF INERTIA
Centroid and moments of an area using a digitizer
[NASA-TM-X-73528] N77-11718
MOMENTUM
Vibration of a flexible spacecraft with momentum exchange controllers
N77-11095
MONATOMIC GASES
Plane shock waves in quantum gases at very low temperatures
N77-11867
MONITORS
An efficient implementation of monitors and condition variables
[AD-A023931] N77-11697
MONOPOLE ANTENNAS
The acoustic monopole in motion
[NASA-TM-X-73985] N77-11816
MONTANA
ERDA energy information data base: Magnetic tape description
[TID-4581-R3] N77-11695
MONTE CARLO METHOD
Iterative forward-adjoint Monte Carlo solutions of the Boltzmann transport equation
N77-11783
MORTARS [MATERIAL]
Effect of polymer state on the mechanical and transport behavior of polymer impregnated mortars
N77-11425
MOTION SIMULATORS
Design and performance of the four-degrees-of-freedom motion system of the NLR research flight simulator
[NLR-MP-75038-U] N77-11072
MOUNTAINS
LANDSAT 2 image studies as applied to a test area in northern Appennine Range
[E77-10030] N77-11493
Development of remote sensing technology in New Zealand, part 1. Seismotectonic, structural, volcanologic and geomorphic study of New Zealand, part 2. Indigenous forest assessment, part 3. Mapping land use and environmental studies in New Zealand, Part 4. New Zealand forest service LANDSAT projects, part 5. Geographical applications in LANDSAT mapping: Landuse mapping and environmental studies, part 6
[E77-10040] N77-11500
MULTICHANNEL COMMUNICATION
Optimal linear coding for a multichannel system
N77-11251
The modeling of message switches in store-and-forward computer communication networks
N77-11252
MULTIMODE RESONATORS
Experimental studies of a continuous-wave HF[DF] confocal unstable resonator
[AD-A025268] N77-11395
MULTIPATH TRANSMISSION
Simulation of an automatically-controlled STOL aircraft in a microwave landing system multipath environment
[NASA-TM-X-73154] N77-11063
MULTIPROCESSING [COMPUTERS]
A hierarchical restructurable multi-microprocessor architecture
N77-11692
MULTISPECTRAL BAND CAMERAS
A spectral reflectance estimation technique using multispectral data from the Viking lander camera
[NASA-TN-D-8292] N77-11099
MULTIVARIATE STATISTICAL ANALYSIS
The multivariable identification package for a PDP-11 computer: User guide
[OUEL-1142/76] N77-11725
MUONS
Transformation of high energy electrons to muons in the Coulomb field of a nucleus
N77-11841
Determination of cosmic ray muon intensities deep underground
N77-11960
MYOCARDIUM
Coronary flow and myocardial biochemical responses to high sustained +G sub z acceleration
N77-11649

N

NASA PROGRAMS
Benefit assessment of NASA space technology goals
[NASA-CR-149192] N77-11914
NASTRAN
Analytical prediction of motor component vibrations driven by acoustic combustion instability
[AD-A025261] N77-11109
NATURAL GAS
User's guide to petroleum industry survey data type
[PB-256635/4] N77-11544
NAVIER-STOKES EQUATION
Vortex/jet/wing viscous interaction theory and analysis
[AD-A025290] N77-11017
Numerical solution of supersonic three-dimensional free-mixing flows using the parabolic-elliptic Navier-Stokes equations
[NASA-TN-D-8195] N77-11342
NAVIGATION AIDS
Rationale and description of a coordinated cockpit display for aircraft flight management
[NASA-TM-X-3457] N77-11044
Navigation input to level C OFT navigation functional subsystem software requirements [rendezvous onorbit-2]
[NASA-CR-151007] N77-11077
NEARSHORE WATER
An assessment of estuarine and nearshore marine environments
[PB-254853/5] N77-11598
NEON
Inelastic neutron scattering in solid neon at high pressure
N77-11829
NETHERLANDS
Research on adhesive bonding and surface characteristics of metals at Fokker-VFW
[FOK-R-1816] N77-11405
NETWORK ANALYSIS
Solution of networks containing a trichotomized class of elements
N77-11714
Parallel multitonic sorting networks
[AD-A024392] N77-11749
Associative processing of network flow problems
[AD-A024380] N77-11750
Efficient solutions in multiobjective tree network location problems
[AD-A025289] N77-11777
NETWORK SYNTHESIS
System identification techniques using the group method of data handling
N77-11713
A study of the remote neighborhood office center concept
[NASA-CR-149190] N77-11892
NETWORKS
The modeling of message switches in store-and-forward computer communication networks
N77-11252
Centralized teleprocessing network design
N77-11260
Adaptive message switching networks
N77-11262
Channel assignment in cellular mobile telecommunication systems
N77-11263
An hierarchic multi-suppliers computer network of a research laboratory with two settlements — real time operation
[NLR-MP-75012-U] N77-11746
NEUROMUSCULAR TRANSMISSION
The effect of 1.6 GHz radiation on neurotransmitters in discrete areas of the rat brain
[AD-A023677] N77-11662
NEUTRINOS
Homogeneous cosmologies with strong neutrino fields
N77-11844
Neutrino astrophysics
[NASA-TT-F-17249] N77-11946
NEUTRON DIFFRACTION
Critical points in magnetic systems, a neutron diffraction study of CsCoCl32D2O
[RCN-235] N77-11885
NEUTRON SCATTERING
Inelastic neutron scattering in solid neon at high pressure
N77-11829
NEUTRON STARS
Escape of charged particles from a neutron star
N77-11934
NEW ENGLAND [US]
The LANDSAT satellite and flood control in New England, June 1976
[E77-10026] N77-11489
Selected priorities: 1978-82. A first-year effort recommending priorities for selected Federal water and related land resource programs in New England
[PB-255890/6] N77-11600
NEW YORK
The operation of hovercraft in New York City metropolitan area. Volume 2: Economic feasibility
[PB-251235/8] N77-11021
Electric energy supply alternatives for New York. Phase 2: An appraisal of electrical energy alternatives available to the State of New York
[PB-249881/4] N77-11575
NEW ZEALAND
Development of remote sensing technology in New Zealand, part 1. Seismotectonic, structural, volcanologic and geomorphic study of New Zealand, part 2. Indigenous forest assessment, part 3. Mapping land use and environmental studies in New Zealand, Part 4. New Zealand forest service LANDSAT projects, part 5. Geographical applications in LANDSAT mapping: Landuse mapping and environmental studies, part 6
[E77-10040] N77-11500
NICKEL
Investigation of critical phenomena in nickel through perturbed angular correlation experiments
N77-11147
On the kinetics and thermodynamics of metallic solid solutions
N77-11150
NICKEL ALLOYS
Effect of microstructure on the fatigue crack growth of a powder metallurgy nickel-base superalloy
N77-11153
Hot hardness of nickel-rich nickel-chromium-aluminum alloys
[NASA-TM-X-3429] N77-11155
Directionally solidified in situ metal matrix composites, part 1 — superalloys for manufacture of turbine blades
[AD-A024217] N77-11162
Development of directionally solidified eutectic nickel and cobalt alloys — for turbine blades
[AD-A024420] N77-11165

NIOBIUM ALLOYS
Susceptibility of cold-worked zirconium-2.5 wt. percent niobium alloy to delayed hydrogen cracking
[AECL-5260] N77-11156
Basic mechanisms providing oxidation resistance in structural metals at high temperatures. Volume 2: The defect structure of nonstoiometric rutile [Ti O2] and nonstoichiometric rutile containing 1 to 10 mole percent Cb205
[AD-A024540] N77-11161

NITRIC OXIDE
Catalytic reduction of nitric oxide with carbon monoxide by rare earth oxides and noble metal catalysts
N77-11567
Calculation of energetics of selected atmospheric systems. Theoretical study of dissociative-recombination of e + NO[+]
[AD-A024309] N77-11629

NITROAMINES
Nitramine propellant research
[NASA-CR-149148] N77-11199

NITROGEN
Development of a Raman system as a combustion diagnostic tool
[AD-A023935] N77-11140
Electrolytic pretreatment unit gaseous effluent conditioning
[NASA-CR-151101] N77-11671
Evaluation of a spacecraft nitrogen generator
[NASA-CR-137930] N77-11672
Tabulation of hybrid theory calculated e-N2 vibrational and rotational cross sections
[NASA-TN-D-8347] N77-11830

NOISE [SOUND]
Characterization of noise sources in hot jets by the crossed beam technique
N77-11238

NOISE INTENSITY
Effects of forward velocity on noise for a J85 turbojet engine with multitube suppressor from wind tunnel and flight tests
[NASA-TM-X-73542] N77-11051

NOISE MEASUREMENT
Core noise source diagnostics on a turbofan engine using correlation and coherence techniques
[NASA-TM-X-73535] N77-11053
Impulsive noise measurement methods and physiological effects
N77-11196
Airport noise monitoring systems, task A
[AD-A028511/4] N77-11821

NOISE POLLUTION
Noise Control Act extension
[GPO-52-021] N77-11910
Economic welfare impacts of urban noise
[PB-256411/0] N77-11933

NOISE PROPAGATION
The acoustic monopole in motion
[NASA-TM-X-73985] N77-11816

NOISE REDUCTION
Economic impact study of the proposed motor vehicle [in-use] noise regulations
[PB-255686/8] N77-11583
Photon limited images and their restoration
[AD-A024027] N77-11700
Measurement and prediction of sound attenuation by buildings using acoustic modeling techniques
N77-11814
Modal density function and number of propagating modes in ducts
[NASA-TM-X-73539] N77-11817
Economic welfare impacts of urban noise
[PB-256411/0] N77-11933

NONDESTRUCTIVE TESTS
Laser scanning of MOS IC's reveals internal logic states nondestructively
[PB-252798/4] N77-11394
On the elastic stability of shells
[NASA-CR-145088] N77-11440
Acoustic emission testing for structural applications
[AD-A024064] N77-11460

NONEQUILIBRIUM CONDITIONS
Microwave response of nonequilibrium superconductors
N77-11879

NONFLAMMABLE MATERIALS
Conference on the Development of Fire-Resistant Aircraft Passenger Seats
[NASA-TM-X-73144] N77-11111

NONLINEAR EQUATIONS
Nonlinear analyses of the stress field near a crack or hole in a plate
N77-11430

NONLINEAR PROGRAMMING
Nonlinear optimization and generalized Lagrange multipliers
[AD-A024413] N77-11793

NONLINEAR SYSTEMS
Some iterative procedures to obtain nonlinear least squares estimates
[AD-A024437] N77-11768
On discrete-time polynomial systems
[AD-A024481] N77-11774

NONLINEARITY
Nonlinear equatorial spread F
[AD-A024440] N77-11623
Conditionally effective evaluations of the parameters of nonlinear models
[NASA-TT-F-17264] N77-11785

NORMAL DENSITY FUNCTIONS
Beam propagation and guiding in anisotropic media, layers and fibers
N77-11869

NORMALIZING [HEAT TREATMENT]
On renormalized kinetic theories of anomalous transport due to hydrodynamic fluctuations in strongly magnetized plasma
N77-11862

NOTCH TESTS
Fracture toughness of 8mm 2024-T3 non clad plate with long central cracks
[FOK-R-1879] N77-11449

NOZZLE EFFICIENCY
Ground test of the D shaped vented thrust vectoring nozzle
[NASA-CR-137959] N77-11107

NOZZLE FLOW
Mach 4 free-jet tunnel starting experiments for a hypersonic research engine model causing high blockage
[NASA-TM-X-3418] N77-11069

NOZZLE GEOMETRY
Ground test of the D shaped vented thrust vectoring nozzle
[NASA-CR-137959] N77-11107
OTW noise correlation for several nozzle/wing geometries using a 5:1 slot nozzle with external deflectors
[NASA-TM-X-73529] N77-11815

NOZZLES
A FORTRAN program for the computation of two-dimensional or axisymmetric nozzles --- applied to supersonic free jets
[ISL-R-110/75] N77-11012

NUCLEAR ELECTRIC POWER GENERATION
Nuclear-powered Hysat spacecraft: Comparative design study
[ERDA-SNS-3063-8] N77-11108

NUCLEAR MAGNETIC RESONANCE
Pulse NMR in solids: Chemical shift, lead fluoride and thorium hydride
N77-11873

NUCLEAR POWER PLANTS
Methodology development for statistical evaluation of reactor safety analyses
[PB-255408/7] N77-11550
The nuclear power plant: Preview of its implications regarding the electricity grid
[INIS-MF-1868] N77-11566

NUCLEAR POWER REACTORS
Research and development for Canadian nuclear power
[AECL-5314] N77-11533

NUCLEAR REACTIONS
Nuclear reactions on the sun
[NASA-TT-F-17267] N77-11954

NUCLEAR REACTORS
The contribution of nuclear technology toward the solution of energy problems
[INIS-MF-1867] N77-11565

NUCLEAR SPIN
Effect of oxygen-catalyzed nuclear spin conversion on the low temperature heat capacity of methane
[LBL-4149] N77-11203
Pion-nucleus scattering and the investigation of nuclear spin dependent effects
N77-11836

NUCLEAR TRANSFORMATIONS
Transformation of high energy electrons to muons in the Coulomb field of a nucleus
N77-11841

NUMERICAL ANALYSIS
Numerical investigation of the flow of a stratified fluid past a flat plate
N77-10996
Discrete modeling and analysis of switching regulators
N77-11287
Numerical solution of supersonic three-dimensional free-mixing flows using the parabolic-elliptic Navier-Stokes equations
[NASA-TN-D-8195] N77-11342
Experimental and numerical studies of rate-dependent materials
N77-11429
Numerical determination of minimum mass structures with specified natural frequencies
[AD-A023655] N77-11463
Numerical solution of two-dimensional integral equations using linear elements
[AD-A023693] N77-11772

NUMERICAL CONTROL
The optimal planning of computerized manufacturing systems
[PB-252887/5] N77-11215
Computer control of distillation column containing analog overrides
N77-11703

NUMERICAL WEATHER FORECASTING
A shooting method for the solution of a discrete Poisson equation on the surface of a sphere
[AD-A024158] N77-11775

O

OBLIQUE COORDINATES
The Knudsen flow between oblique plates
[REPT-1/1976] N77-11347

OCEAN CURRENTS
Investigation of environmental change pattern in Japan
[E77-10025] N77-11488

OCEAN MODELS
Earth and ocean modeling
[NASA-CR-150055] N77-11617

OCEAN SURFACE
An investigation of optically relevant turbulence parameters in the marine boundary layer
[AD-A025421] N77-11631

OCEANOGRAPHY
LANDSAT menhaden and thread herring resources investigation, Gulf of Mexico
[E77-10036] N77-11497

ODORS
Electrochemical analysis of sulfidic and amine odorants
[PB-255092/9] N77-11591

OFFSHORE ENERGY SOURCES
Identification and analysis of mid-Atlantic onshore OCS impact
[PB-254925/1] N77-11516

OFFSHORE PLATFORMS
The development of steel plate for offshore structures
[PB-254195/1] N77-11453

OHMIC DISSIPATION
Nonstationary analysis of ohmic and viscous heating of a cylindrical plasma shell
[TRITA-EPP-75-19] N77-11864

OIL EXPLORATION
The 29950 Earth Resource Technology Satellite [ERTS-A] sensor data for mineral resource sector development and regional land use survey, March - August 1976 --- Bolivia
[E77-10028] N77-11491

OMNIDIRECTIONAL ANTENNAS
Airborne antenna polarization study for the microwave landing system
[NASA-TM-X-73952] N77-11266

OPEN CHANNEL FLOW
Penetration and mixing of heated discharges into waterways
[PB-253957/5] N77-11580

OPERATING SYSTEMS [COMPUTERS]
MULTI8, the PDP8 real-time operating system for multitasking foreground- and timesharing background operation. Part I: Introduction to MULTI8
[MBL-1975-7] N77-11724

OPERATIONS RESEARCH
Trade-off analyses for multi-objective transportation plans
N77-11911

OPERATOR PERFORMANCE
SAINT II documentation manual
[AD-A024286] N77-11689

OPTICAL COMMUNICATION
Development of an optical fiber video data link
[AD-A025220] N77-11027
The application of doubly stochastic Poisson process estimation techniques to optical communication through log-normal fading channels
N77-11782

OPTICAL DATA PROCESSING
RM2: rms error comparisons
[NASA-CR-149150] N77-11717
Computer program for converting visual display from DEC, GT-44 to Stromberg datagraphi X4020
[AD-A025081] N77-11736
OCR and its application to documentation: A state of the art review
[AGARD-AG-216] N77-11907

OPTICAL DENSITY
Reduction of target detectability by laser protective materials
[AD-A024383] N77-11682

OPTICAL EMISSION SPECTROSCOPY
Rayleigh linewidth measurements in liquid helium
N77-11209

OPTICAL EQUIPMENT
Current problems of optical interferometry used in experimental gas dynamics
N77-11244
Periodic integrated optical structures in photoresist: Application to grating couplers
N77-11847

OPTICAL MEASUREMENT
Optical measurements of thermodynamic properties in flow fields. A review
N77-11233
Eight-year applied optics research report
[AD-A025340] N77-11857

OPTICAL MEASURING INSTRUMENTS
Optical method for measuring the mass concentration of particulate emissions
[PB-255093/7] N77-11384
Eight-year applied optics research report
[AD-A025340] N77-11857
A study of the 6180 angstrom diffuse interstellar band
N77-11942

OPTICAL PATHS
The effects of optimal path pertubations during recording on a reconstructed holographic image
N77-11361

OPTICAL PROPERTIES
Nonlinear optical properties and crystal growth of II-IV-V2 chalcopyrite semiconductors
N77-11870

OPTICAL RADAR
Airborne LIDAR Raps studies, February 1974 — for computerized air pollution monitoring
[PB-255886/4] N77-11601

OPTICAL REFLECTION
The theoretical reflectance of X-rays from optical surfaces
[NASA-TN-D-8366] N77-11853

OPTICAL RESONATORS
Mode properties in unstable optical resonators
N77-11850

OPTICAL SCANNERS
Scanning radiometer for measurement of forward-scattered light to determine mean diameter of spray particles
[NASA-TM-X-3454] N77-11366

OPTICAL WAVEGUIDES
Polarization-independent optical waveguides
N77-11849
Radiation and coupling properties of straight and curved optical waveguides
N77-11851
Optical surface waveguide discontinuities
N77-11852

OPTIMAL CONTROL
The optimal planning of computerized manufacturing systems
[PB-252887/5] N77-11215
Frequency domain solution of the optimum steady-state regulator problem
[OUEL-1145/76] N77-11756
Nonlinear optimization and generalized Lagrange multipliers
[AD-A024413] N77-11793

OPTIMIZATION
The spot frequency design of optimum embedding networks for RF switching, modulation, and phase shifting using power limited switches
N77-11284
Optimized selective coatings for solar collectors
[NASA-TM-X-73498] N77-11529
Efficient solutions in multiobjective tree network location problems
[AD-A025289] N77-11777

ORBIT PERTURBATION
A new atmospheric model and earth-satellite motion
[NASA-TT-F-17108] N77-11614

ORBITAL MECHANICS
Navigation input to level C OFT navigation functional subsystem software requirements [rendezvous onorbit-2]
[NASA-CR-151007] N77-11077

ORBITAL POSITION ESTIMATION
Computational results of the NISLAP and AIM-LASER programs for satellite position predictions — noting program accuracy and perturbing forces
[VTH-212] N77-11080

ORBITAL SPACE STATIONS
Space station systems analysis study. Part 1, volume 1: Executive study
[NASA-CR-151102] N77-11084
Space station systems analysis study. Part 1, volume 2: Technical report
[NASA-CR-151103] N77-11085

ORDNANCE
Analysis of unified testing theory — reliability testing for munition components
[AD-A023872] N77-11791

ORGANIC MATERIALS
Sources of organic color in natural waters
N77-11484
Aerobic biological treatment of a colloidal wastewater
N77-11568

ORGANIC SULFUR COMPOUNDS
Electrochemical analysis of sulfidic and amine odorants
[PB-255092/9] N77-11591

ORGANIZATIONS
Application of principles of organizational structure to high technology activities
[AD-A024012] N77-11895

ORION CONSTELLATION
A photometric study of the Orion OB 1 association. 2: Photometric analysis
[NASA-TM-X-71217] N77-11936

ORR-SOMMERFELD EQUATIONS
The eigenvalue spectrum of the Orr-Sommerfeld problem
[NASA-TR-R-469] N77-11344

ORTHOPEDICS
Potential biomedical applications of ion beam technology
[NASA-TM-X-73512] N77-11655

OSCILLATING FLOW
Analytical prediction of motor component vibrations driven by acoustic combustion instability
[AD-A025261] N77-11109

OSCILLATIONS
Experimental and analytical study of thermal acoustic oscillations — in the transfer and storage of cryogens
[NASA-CR-150051] N77-11212

OSO-7
Observation of the galactic hard X-ray background from the OSO-7 satellite
N77-11963

OSO-8
Spectra of Her X-1 near a turn-on in the 35-day cycle
[NASA-TM-X-71213] N77-11935

OXIDATION
The oxidation of T-111 alloy at high termperatures and low pressures
N77-11145

OXIDATION RESISTANCE
Refinement of promising coating compositions for directionally cast eutectics
[NASA-CR-135103] N77-11154
Basic mechanisms providing oxidation resistance in structural metals at high temperatures. Volume 2: The defect structure of nonstoiometric rutile [Ti O2] and nonstoichiometric rutile containing 1 to 10 mole percent Cb205
[AD-A024540] N77-11161

OXIDE FILMS
Electron-microscopical studies of passive films on stainless steels
[PB-255190/1] N77-11168

OXYGEN
Effect of oxygen-catalyzed nuclear spin conversion on the low temperature heat capacity of methane
[LBL-4149] N77-11203
Electrolytic pretreatment unit gaseous effluent conditioning
[NASA-CR-151101] N77-11671

OXYGEN CONSUMPTION
Sediment studies in Back River Estuary, Baltimore, Maryland
[PB-255584/5] N77-11594

OXYGEN TENSION
The development of chronic insertable oxygen electrodes
[AD-A024633] N77-11657

OXYGENATION
Development studies on conversion of methanol and related oxygenates to gasoline
[FE-1773-14] N77-11202

OZONE
The covariance of temperature and ozone due to planetary-wave forcing
[NASA-TM-X-71212] N77-11613
Preliminary report on electron energy-loss measurements for CClF3, CCl2F2, and CCl3F
[PB-255227/1] N77-11630

P

P-N JUNCTIONS
Development of processes for simultaneous diffusion of several dopant junction or doping elements for power devices
[BMFT-FB-T-76-16] N77-11305

PACKINGS [SEALS]
A new ceramic flat pack for quartz resonators
[AD-A024074] N77-11310

PAINTS
Passivation of pigment particles for thermal control coatings
[NASA-CR-150046] N77-11174

PALLADIUM
Linear polarization measurements on gamma rays from Pd-100, Pd-102, Pd-104 and Pd-106
N77-11958

PARABOLIC ANTENNAS
Electric field in the focal region of an offset parabolic receiving antenna
N77-11256

PARALLEL PROCESSING [COMPUTERS]
An efficient implementation of monitors and condition variables
[AD-A023931] N77-11697
The complexity of parallel algorithms
N77-11707
Parallel multitonic sorting networks
[AD-A024392] N77-11749

PARAMETERIZATION
On the theory of the electromagnetic seismograph — - parametrization for earth movement magnification
[KNMI-102-95] N77-11619

PARITY
Some results in majority decoding of binary cyclic codes
N77-11711

PARTICLE COLLISIONS
Zeros of the multiparticle generating function in hadronic scattering models
N77-11825

PARTICLE FLUX DENSITY
Application of the maximum plausibility method to the problem of determination of the intensities of an intermixed poisson flux
[NASA-TT-F-17265] N77-11786

PARTICLE INTERACTIONS
Brownian motion of interacting particles
N77-11824
Pion-nucleus scattering and the investigation of nuclear spin dependent effects
N77-11836

PARTICLE MOTION
Space shuttle contamination due to backflow from control motor exhaust
[NASA-CR-150054] N77-11092
Brownian motion of interacting particles
N77-11824

PARTICLE PRODUCTION
Zeros of the multiparticle generating function in hadronic scattering models
N77-11825

PARTICLE SIZE DISTRIBUTION
Scanning radiometer for measurement of forward-scattered light to determine mean diameter of spray particles
[NASA-TM-X-3454] N77-11366

PARTITIONS [MATHEMATICS]
Sequential partition detectors with applications
N77-11781

PASSIVITY
Chemical breakdown of passivity
[PB-255102/4] N77-11169
Passivation of pigment particles for thermal control coatings
[NASA-CR-150046] N77-11174
Development of new active semiconductor surface passivation technologies for high blocking voltage power devices — thyristors
[BMFT-FB-T-76-15] N77-11304

PATTERN RECOGNITION
Investigation of environmental change pattern in Japan
[E77-10025] N77-11488
Digital image processing
[E77-10035] N77-11496
MATCH package for the ANL three-view geometry program
[ANL/HEP/PR-76-11] N77-11719
Robust statistical techniques in pattern recognition: Gray-level and edge detection
N77-11753
Knowledge acquisition from structural descriptions
[AD-A025074] N77-11759

PAVEMENTS
Follow-up study for the California resilience design method
[PB-255121/6] N77-11454
Validation of soil stabilization index system with manual development
[AD-A024549] N77-11456
Improvement of Utah's flexible pavement performance system
[PB-254819/6] N77-11462
Highway insulating material evaluation
[PB-254792/5] N77-11466
Rigid pavement joints and sealants study
[PB-254806/3] N77-11469
Polymer pavement concrete for Arizona study 2
[PB-255692/6] N77-11470
Accelerated test development for Portland cement concrete
[PB-255714/8] N77-11472
Thermal activity of base course material related to pavement cracking
[PB-254754/5] N77-11476

PAYLOADS
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 2: Scientific objectives and passive sounder instruments
[ESA-CR[P]-836-VOL-2] N77-11088
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 3: Accommodation of instruments and packages on Spacelab
[ESA-CR[P]-836-VOL-3] N77-11089

PDP 8 COMPUTER
MULTI8, the PDP8 real-time operating system for multitasking foreground- and timesharing background operation. Part 1: Introduction to MULTI8
[MBL-1975-7] N77-11724

PDP 11 COMPUTER
System design of functional memory based processors
N77-11691

The multivariable identification package for a PDP-11 computer: User guide
[OUEL-1142/76] N77-11725
PENETRATION
Three-dimensional finite element analysis of a large circular disc with circular penetrations
[WAPD-TM-1206] N77-11444
Penetration and mixing of heated discharges into waterways
[PB-253957/5] N77-11580
PENNSYLVANIA
Characterization and evaluation of wastewater sources United States Steel Corporation, Homestead wheel and axle plant, McKees Rocks, Pennsylvania, August 21-28, 1975
[PB-255593/6] N77-11586
Characterization and evaluation of wastewater sources United States Steel Corporation, Duquesne plant, Pittsburgh, Pennsylvania, February 26 - March 6, 1976
[PB-255594/4] N77-11587
PERFORMANCE PREDICTION
Description and expected performance of flight-model, 12-gigahertz, output stage tube for the communications technology satellite
[NASA-TM-X-3441] N77-11295
Investigation of performance limits in axial groove heat pipes
[NASA-CR-137912] N77-11340
Measurement of computer communication networks
[PB-255618/1] N77-11747
Design of stochastic linear control systems according to cumulant based performance criteria
[AD-A025078] N77-11795
PERFORMANCE TESTS
Performance documentation of the engineering model 30-cm diameter thruster
[NASA-TM-X-73530] N77-11103
Repetitively pulsed cold cathode studies
[AD-A024354] N77-11317
PERMALLOYS [TRADEMARK]
Field effect in ferromagnetic metals
N77-11881
PERMEABILITY
The permeation of gases through polyethylene membranes at high pressures. A free-volume model of permeation
N77-11323
PERSONNEL DEVELOPMENT
Program Evaluation and Review Technique [PERT]: A planning and control tool for occupational field studies --- training and reference material for new personnel and project directors
[AD-A024131] N77-11897
PERTURBATION
The effects of optimal path pertubations during recording on a reconstructed holographic image
N77-11361
PERU
Application of remote sensing techniques for the study and evaluation of natural resources in Peru
[E77-10024] N77-11487
PH
Spectral reflectance signatures of coastal pollutants --- Delaware
[E77-10011] N77-11486
PHASE LOCKED SYSTEMS
Investigation and optimum design of the generalized second-order phase-locked loop
N77-11264
PHASE SHIFT
The spot frequency design of optimum embedding networks for RF switching, modulation, and phase shifting using power limited switches
N77-11284
PHASE TRANSFORMATIONS
Utilization and limitations of phase transformations and microstructures in alloy design for strength and toughness
[LBL-4175] N77-11157
Strain energy criterion of martensitic transformation
[AD-A023781] N77-11163
PHASE VELOCITY
The infinitely long Yagi array of concentric circular loops
N77-11253
PHASED ARRAYS
Transient behavior of an adaptive array
N77-11250
Phase scanned array bandwidth limitations in a wideband radar system
N77-11265
PHILIPPINES
Report to AID on a Phillipines survey on standardization and measurement services
[PB-255803/9] N77-11216
PHOSPHIDES
Investigation of electro[illegible]nsport, recombination and optical properties in As sub 1-x P sub x alloy systems
[AD-A025294] N77-11889
PHOTOCHEMICAL REACTIONS
Analysis of the data from the three-dimensional gradient study --- for atmospheric pollutant layers diffusion
[PB-253936/9] N77-11578
PHOTOCONDUCTORS
Periodic integrated optical structures in photoresist: Application to grating couplers
N77-11847
PHOTOELECTRIC EFFECT
A photocurrent spectroscopic method for determination of trapping state distributions in silicon dioxide thin films
N77-11875
PHOTOELECTRIC EMISSION
Improved microwave-discharge source for UV photoemission
[PB-255204/0] N77-11382
PHOTOGRAPHIC PROCESSING
Photolithographic techniques for Surface Acoustic Wave [SAW] devices
[AD-A025492] N77-11822
PHOTOGRAPHIC RECORDING
Polychromatic light holography
[ISL-R-124/75] N77-11372
PHOTOLUMINESCENT BANDS
A study of the 6180 angstrom diffuse interstellar band
N77-11942
PHOTOMAPPING
AS-11B-X automated stereomapper
[AD-A025428] N77-11524
PHOTOMETERS
Solar power array for the concentration of energy. Task 2: Modifications to a specular photometer
[COO-2699-3] N77-11538
PHOTOMETRY
Review of the CIE photometric model and of the status of radiometric measurements
[PB-255209/9] N77-11383
A photometric study of the Orion OB 1 association. 2: Photometric analysis
[NASA-TM-X-71217] N77-11936
PHOTOMULTIPLIER TUBES
The detection capabilities of gallium arsenide and s-20 photo-multiplier tubes to go-type, point-source, signals
[AD-A023818] N77-11314
PHOTONS
Development of photon correlation anemometry for application to supersonic flows
N77-11231
Measurement of periodic flows using laser Doppler correlation techniques
N77-11232
Photon limited images and their restoration
[AD-A024027] N77-11700
PHOTOVOLTAIC CELLS
Applied research on II-VI compound
[PB-254637/2] N77-11547
PHYSICAL PROPERTIES
Contributions to the study of the physical properties of carbon
[NASA-TT-F-17246] N77-11117
Investigation of stress levels causing significant damage in composites
[AD-A024537] N77-11127
Theoretical, numerical, and physical techniques for characterizing power plant plumes
[PB-253099/6] N77-11599
PHYSIOLOGICAL EFFECTS
Impulsive noise measurement methods and physiological effects
N77-11196
PHYSIOLOGICAL RESPONSES
Study of metabolic response variation to an acoustic aggression --- metabolic recuperation after sonic boom N wave exposure
[ISL-R-120/75] N77-11641
Cardiovascular, renal and respiratory effects of high intensity, intermediate duration, low frequency vibration
[AD-A025098] N77-11664
Biomedical technology transfer: Applications of NASA science and technology
N77-11915
PHYSIOLOGY
Principles of biodynamics. Volume 3: Physiological mechanisms in the mammal underlying posture, locomotion, and orientation in space
[AD-A023691] N77-11661
PIEZOELECTRIC TRANSDUCERS
A new technique for measuring Doppler effect
N77-11360
PILOT PERFORMANCE
A flight investigation of piloting techniques and crosswind limitations during visual STOL-type landing operations
[NASA-TN-D-8284] N77-11001
Display/control requirements for VTOL aircraft
[NASA-CR-145026] N77-11030
Landing practices of general aviation pilots in single-engine light airplanes
[NASA-TN-D-8283] N77-11033
Helicopter yaw axis augmentation investigation
[AD-A024512] N77-11066
Paths of movement for selected body segments during typical pilot tasks
[AD-A025773] N77-11520
Pilot workload and fatigue: A critical survey of concepts and assessment techniques
[NASA-TN-D-8365] N77-11674
Influence of pilot incapacitation on low speed and hovering flight
[AD-A023728] N77-11684
PILOT TRAINING
Enhancement of human effectiveness in system design, training, and operation: July 1974 - June 1975
[AD-A023941] N77-11687
PILOTS [PERSONNEL]
Utilization of human centrifuge for training military pilots in the execution of protective straining maneuvers
N77-11651
PIONS
Pion-nucleus scattering and the investigation of nuclear spin dependent effects
N77-11836
PIPELINES
Application of remote sensing techniques for the study and evaluation of natural resources in Peru
[E77-10024] N77-11487
PIPES [TUBES]
A composite transer matrix-synthesis approach to piping dynamic analysis
N77-11334
PISTON ENGINES
Power transfer units for aircraft hydraulic systems
[AD-A024446] N77-11058
PISTON THEORY
Optimum step design for centering of pistons moving in an incompressible fluid
[NASA-TN-D-8345] N77-11402
PISTONS
Optimum step design for centering of pistons moving in an incompressible fluid
[NASA-TN-D-8345] N77-11402
PLANETARY ATMOSPHERES
Modeling dynamic processes in planetary atmospheres. Part 1: Apparatus for studying shear flow stability in spherical layers, preliminary results
[NASA-TT-F-17262] N77-11951
Solar wind induced currents in the atmospheres of non-magnetic planets
N77-11953
PLASMA CONTROL
Second harmonic generation in a bounded magnetoplasma
N77-11860
PLASMA DIAGNOSTICS
Interferometry of transient phenomena using lasers emitting at different wavelengths in the UV, visible, and infrared spectral range
[ISL-36/74] N77-11368
PLASMA GUNS
Velocity limitations in coaxial plasma gun experiments with gas mixtures
[TRITA-EPP-76-02] N77-11865
PLASMA HEATING
High reliability cathode heaters for ion thrusters
[NASA-TM-X-73538] N77-11105
PLASMA LAYERS
Observations of plasma in the geomagnetic tail at lunar distances
N77-11961
PLASMA OSCILLATIONS
Pump wavenumber dependent effects in the parametric instabilities of a plasma
N77-11863
PLASMA PHYSICS
Transport processes within a plasma driven by a high-frequency electric field
N77-11859
PLASMA WAVES
Time variations of HF induced plasma waves
N77-11611
Pump wavenumber dependent effects in the parametric instabilities of a plasma
N77-11863
PLASMA-ELECTROMAGNETIC INTERACTION
Transport processes within a plasma driven by a high-frequency electric field
N77-11859
Observations at the planet Mercury by the plasma electron experiment, Mariner 10
[NASA-TM-X-71210] N77-11944
PLASMAS [PHYSICS]
An experimental and theoretical study of the propagation of high amplitude pulses in a bounded magneto-plasma
N77-11861
A study of X-ray emission from laser heated plasma
[AD-A025498] N77-11866
PLASTIC DEFORMATION
Additional energy solutions for predicting structural deformations
[AD-A024591] N77-11464

PLASTICS
Tresca yield condition in elastic-plastic finite element analysis
N77-11424
PLATES [STRUCTURAL MEMBERS]
Local instability of sandwich plates — wrinkling problems
N77-11426
PLOTTERS
AS-11B-X automated stereomapper
[AD-A025428] N77-11524
PLUMES
Theoretical, numerical, and physical techniques for characterizing power plant plumes
[PB-253099/6] N77-11599
PNEUMATIC EQUIPMENT
Development of mathematical model for pneumatic tire-soil interaction in layered soils
[AD-A024162] N77-11416
POGO EFFECTS
Development of dynamic calibration methods for pogo pressure transducers — for space shuttle
[NASA-CR-149193] N77-11367
POISSON DENSITY FUNCTIONS
Application of the maximum plausibility method to the problem of determination of the intensities of an intermixed poisson flux
[NASA-TT-F-17265] N77-11786
POISSON EQUATION
A shooting method for the solution of a discrete Poisson equation on the surface of a sphere
[AD-A024158] N77-11775
POLAR REGIONS
Interplanetary sector structure 1947 - 1975
[NASA-CR-149175] N77-11948
POLARITY
Comment on 'Kp dependence on sectors, by I. B. McDiarmid and E. E. Budzinski
[NASA-CR-149176] N77-11624
POLARIZATION [CHARGE SEPARATION]
Polarization induced surface dipole moments
[AD-A024387] N77-11159
POLARIZATION [WAVES]
Polarization-independent optical waveguides
N77-11849
Linear polarization measurements on gamma rays from Pd-100, Pd-102, Pd-104 and Pd-106
N77-11958
POLARIZATION CHARACTERISTICS
Airborne antenna polarization study for the microwave landing system
[NASA-TM-X-73952] N77-11266
POLLUTION CONTROL
Field test sampling/analytical strategies and implementation cost estimates: Coal gasification and flue gas desulfurization
[PB-254166/2] N77-11581
The air quality and economic implications of supplementary control systems in Illinois — considering electric power plant fuels
[PB-255699/1] N77-11588
Particulate collection efficiency measurements on an electrostatic precipitator installed on a paper mill recovery boiler
[PB-255297/4] N77-11596
Evaluation of Rexnord gravel bed filter
[PB-255095/2] N77-11597
Investigation and assessment of light-duty-vehicle evaporative emission sources and control
[PB-255813/8] N77-11603
Guidelines for air quality maintenance planning and analysis. Volume 14. Designated air quality maintenance areas
[PB-254961/6] N77-11606
Noise Control Act extension
[GPO-52-021] N77-11910
POLLUTION MONITORING
Development of fuel cell CO detection instruments for use in a mine atmosphere
[PB-254823/8] N77-11380
Air pollution monitoring at the Redcar site: Measurement of grit and dust [3d]
[PB-254199/3] N77-11579
Designing a river basin sampling system
[PB-255022/6] N77-11593
Design, development, fabrication and testing of a portable self-contained respirable dust mass monitor
[PB-254503/6] N77-11681
Optics research — report on laser technology and propagation and pollution studies
[AD-A025338] N77-11856
POLYETHYLENES
The permeation of gases through polyethylene membranes at high pressures. A free-volume model of permeation
N77-11323
POLYMER CHEMISTRY
Thixotropic properties of polymer melts
N77-11173
Solid Polymer Electrolyte [SPE] fuel cell technology, program review, phase 2
[NASA-CR-150957] N77-11532
POLYMERIZATION
The initiator-activator relationship in the cold-cured polymerization of methylmethacrylate
[AD-A023678] N77-11179
POLYMERS
Structure-property relationships bibenzoxazole polymers containing fluorocarbon linkages
[AD-A023822] N77-11180
The effect of strain rate and temperature on polymers
[AD-A023774] N77-11181
Mechanisms of adhesion failure between polymers and metallic substrates. Part 2: Aluminum 2024-T3 and titanium 6Al4V with HT424 adhesive
[AD-A025256] N77-11183
POLYMETHYL METHACRYLATE
The initiator-activator relationship in the cold-cured polymerization of methylmethacrylate
[AD-A023678] N77-11179
Effect of polymer state on the mechanical and transport behavior of polymer impregnated mortars
N77-11425
POLYNOMIALS
System identification techniques using the group method of data handling
N77-11713
Optimal order reduction
N77-11745
Piecewise polynomial functions
[UCID-17059] N77-11767
On discrete-time polynomial systems
[AD-A024481] N77-11774
Higher K-theory of regular rings
N77-11804
POLYTROPIC PROCESSES
Composition and equation of state of thermally dissociated matter and mass and stability of rigidly rotating relativistic polytropes
N77-11843
POROUS BOUNDARY LAYER CONTROL
Viscous flow at the boundary of a porous material
[AD-A022715] N77-11351
POROUS MATERIALS
Chemically reacting flows in porous media
N77-11327
Viscous flow at the boundary of a porous material
[AD-A022715] N77-11351
POROUS WALLS
The effect of finite test section length on wall interference in 2-D ventilated wind tunnels
[NLR-MP-75036-U] N77-11071
POSITION [LOCATION]
Location variability of transmission loss: Land mobile and broadcast systems
[PB-254472/4] N77-11272
POSITIONING
Compressor blade setting angle accuracy study, volume I
[NASA-CR-135068-VOL-1] N77-11046
Compressor blade setting angle accuracy study. Volume 2: Data compilation
[NASA-CR-135068-VOL-2] N77-11047
POTABLE WATER
ASTP chemical and microbiological analysis of potable water
[NASA-TM-X-58192] N77-11675
POTASSIUM COMPOUNDS
Evaluation of potassium titanate as a component of alkaline fuel cell matrices
[NASA-TN-D-8341] N77-11175
POTENTIOMETERS [INSTRUMENTS]
Angle detector
[NASA-CASE-ARC-11036-1] N77-11364
POWDER METALLURGY
Prevention of defects in powder preform forging
N77-11148
POWER EFFICIENCY
Multi-year time frame optimization of power systems with fossil, nuclear, hydro, pumped storage and peaking units
N77-11525
POWER SPECTRA
Investigation of the effects of nonhomogeneous [or nonstationary] behavior on the spectra of atmospheric turbulence
[NASA-CR-2745] N77-11034
POWER SUPPLIES
Multi-year time frame optimization of power systems with fossil, nuclear, hydro, pumped storage and peaking units
N77-11525
PRECIPITATION [METEOROLOGY]
Estimating probability of multiple occurrence of annual daily maximum rainfall
N77-11634
PRECONDITIONING
Influence of a precursor noise on the global action potential consecutive to an impulse noise in the Guinea pig
[ISL-R-115/75] N77-11640
PREDICTION ANALYSIS TECHNIQUES
The AFFDL-Nielsen flow-field study
[AD-A023755] N77-11015
Helicopter reliability growth evaluation
[AD-A025265] N77-11041
A theoretical prediction technique for lateral hydrodynamic loads on sidewalks of surface-effects ships
[AD-A024510] N77-11220
Time domain filtering, estimation and prediction techniques in power systems
N77-11285
Estimating external blast loads from suppressive structures
[AD-A025503] N77-11480
Measurement and prediction of sound attenuation by highway barriers using acoustic modeling techniques
N77-11812
PREDICTIONS
Computational results of the NISLAP and AIM-LASER programs for satellite position predictions — noting program accuracy and perturbing forces
[VTH-212] N77-11080
PREFORMS
Prevention of defects in powder preform forging
N77-11148
PREMIXED FLAMES
Pollutant formation and multiple stationary states in radiantly stabilized flames
N77-11133
Investigation of a V-gutter stabilized flame by laser anemometry and schlieren photography
N77-11246
PRESSURE DISTRIBUTION
The inviscid pressure field on the tip of a semi-infinite wing and its application to the formation of a tip vortex
[NASA-CR-2748] N77-11345
PRESSURE EFFECTS
Nonaxisymmetric incompressible hydrostatic pressure effects in radial face seals
[NASA-TN-D-8343] N77-11401
PRESSURE GAGES
Resonant pressure instrumentation
N77-11358
PRESSURE GRADIENTS
Structure of two-dimensional turbulent wall-jets in the presence of adverse pressure gradients
[NASA-CR-149126] N77-11354
PRESSURE PULSES
Impulsive noise measurement methods and physiological effects
N77-11196
PRESSURE SENSORS
Development of dynamic calibration methods for pogo pressure transducers — for space shuttle
[NASA-CR-149193] N77-11367
PRESTRESSING
Fracture toughness tests on compressive preloaded specimens with a thickness of 5 mm — in crack presence
[FOK-R-1839] N77-11448
PROBABILITY DISTRIBUTION FUNCTIONS
Design of stochastic linear control systems according to cumulant based performance criteria
[AD-A025078] N77-11795
PROBABILITY THEORY
Estimating probability of multiple occurrence of annual daily maximum rainfall
N77-11634
Probability measures on algebras
N77-11780
Mathematical statistics and probability: Stochastic processes
[AD-A024082] N77-11787
PROBLEM SOLVING
Solution of networks containing a trichotomized class of elements
N77-11714
PRODUCT DEVELOPMENT
Spherical bearing
[NASA-CASE-MFS-23447-1] N77-11403
The development of chronic insertable oxygen electrodes
[AD-A024633] N77-11657
PRODUCTION ENGINEERING
The production and refining of crude oil into military fuels
[AD-A024652] N77-11207
The optimal planning of computerized manufacturing systems
[PB-252887/5] N77-11215
Manufacturing methods and technology engineering high efficiency high power gallium arsenide read-type IMPATT diodes
[AD-A023913] N77-11309
Production engineering measures to manufacture super fine finish beryllia
[AD-A024470] N77-11315
Industrial development of silicon solar cells
[NASA-TT-F-17139] N77-11528
PRODUCTION MANAGEMENT
Shot peening procedures for helical compression springs
[AD-A023758] N77-11415
The evaluation of integrated market research information systems for new product decisions
N77-11900

PRODUCTIVITY
Optimal productivity for solid waste collection: A systems approach
N77-11913
PROFILE METHOD (FORECASTING)
Parametric study of predictor accuracy impact on OFT rendezvous targeting
[NASA-CR-151094] N77-11078
PROGRAM TREND LINE ANALYSIS
Guidelines for research planning and design in task analysis
[AD-A024132] N77-11898
PROGRAMMING (SCHEDULING)
A systematic approach to operational scheduling for information collection systems
N77-11483
PROGRAMMING LANGUAGES
CALFLO: A basic language program used in the calibration of Vol-O-Flow meters
[AD-A025466] N77-11388
A demonstration of the feasibility of using English as a programming language
N77-11708
STIL: A static tool implementation language
[UCID-17014] N77-11722
Graph information retrieval language: Programming manual for FORTRAN complement, revision 1
[AD-A025292] N77-11735
The class concept in the SIMULA programming language
[PB-256045/6] N77-11738
PROJECT MANAGEMENT
Continuing research in the development of interactive man-computer systems for engineering-construction projects
[PB-252927/9] N77-11679
Project screening
[AD-A023837] N77-11894
A conceptual model for evaluating contractor management during source selection
[AD-A023817] N77-11896
PROJECT PLANNING
Project screening
[AD-A023837] N77-11894
Program Evaluation and Review Technique [PERT]: A planning and control tool for occupational field studies --- training and reference material for new personnel and project directors
[AD-A024131] N77-11897
PROJECTILE CRATERING
Application of hypervelocity backward reference holography to the study of dynamic deformations
[ISL-R-135/75] N77-11375
Behavior of steel fragments on thin Duralumin targets. Oblique incidence. Multiple targets
[ISL-R-112/75] N77-11406
PROJECTILES
An improved projectile boattail, part 2
[AD-A024073] N77-11016
PROPAGATION MODES
Modal density function and number of propagating modes in ducts
[NASA-TM-X-73539] N77-11817
PROPANE
Pollutant formation and multiple stationary states in radiantly stabilized flames
N77-11133
Investigation of a V-gutter stabilized flame by laser anemometry and schlieren photography
N77-11246
PROPELLANT COMBUSTION
Nitramine propellant research
[NASA-CR-149148] N77-11199
PROPELLANT STORABILITY
Propellant material compatibility program and results
[NASA-CR-149149] N77-11197
PROPELLER DRIVE
Performance and optimum design analysis/computation for propeller type wind turbines
N77-11527
PROPULSION SYSTEM PERFORMANCE
Specifications of the propulsion systems for anti-tank rockets
N77-11187
PROTECTIVE COATINGS
Intumescent coating containing 4.4'-dinitrosulfanilide
[NASA-CASE-ARC-11042-1] N77-11119
Refinement of promising coating compositions for directionally cast eutectics
[NASA-CR-135103] N77-11154
PROTON ENERGY
Measurements of energy losses, distributions of energy loss and additivity of energy losses for 50 to 150 KeV protons in hydrogen and nine hydrocarbon gases
N77-11823
PROTONS
Studies of thick target fast neutron production and proton activation of the stable isotope tracer Ca-48 as applications of nuclear physics in medicine
N77-11837
PSYCHOMOTOR PERFORMANCE
S2 probability and CNV [Contingent Negative Variation] --- signal detection task and selective reaction time task
[IZF-1975-11] N77-11668
PUBLIC HEALTH
Potential role of remote sensing in disaster relief management
[NASA-CR-149102] N77-11502
Determination and possible public health impact of transition metal sulfite aerosol species
[PB-255407/9] N77-11590
Evaluation of the feasibility of an independent HSA data base relative to proposed HSA budgets and staffing
[PB-254920/2] N77-11903
PULSE AMPLITUDE
Shape analysis of pulsed second sound in superfluid helium
N77-11210
PULSE DIFFRACTION
Diffraction by wedges and cones
N77-11848
PULSE HEATING
An experimental and theoretical study of the propagation of high amplitude pulses in a bounded magneto-plasma
N77-11861
PULSED LASERS
Development of a Raman system as a combustion diagnostic tool
[AD-A023935] N77-11140
Optics research --- report on laser technology and propagation and pollution studies
[AD-A025338] N77-11856
PULSED RADIATION
Repetitively pulsed cold cathode studies
[AD-A024354] N77-11317
A study of X-ray emission from laser heated plasma
[AD-A025498] N77-11866
PUMPS
Power transfer units for aircraft hydraulic systems
[AD-A024446] N77-11058
PYRITES
Nonlinear optical properties and crystal growth of II-IV-V2 chalcopyrite semiconductors
N77-11870
PYROLYSIS
Basic studies of coal pyrolysis and hydrogasification
[PB-254878/2] N77-11511
PYROTECHNICS
New methods for the measurement of relative ignitability and ignition efficiency
[AD-A023862] N77-11206

Q

QUADRATIC PROGRAMMING
Special cases of the quadratic assignment problem
[AD-A025605] N77-11740
QUALITY CONTROL
Procedure for maintenance and rework process quality control based on random sampling
[AD-A024257] N77-11421
Technical Report accompanying procedure for maintenance and rework process quality control based on random sampling
[AD-A024256] N77-11422
Regional air pollution study: Quality assurance audits
[PB-255313/9] N77-11605
Automatic program testing
N77-11716
QUANTITATIVE ANALYSIS
Errors observed in quantitative ion microprobe analysis
[PB-252400/7] N77-11378
QUANTUM ELECTRODYNAMICS
A study of some two-dimensional field theory models
N77-11835
QUANTUM MECHANICS
Quantum size oscillations and size effects
N77-11877
QUARTZ CRYSTALS
A new ceramic flat pack for quartz resonators
[AD-A024074] N77-11310
QUEUEING THEORY
Queuing analysis of an IBM 370 computer system
[AD-A025270] N77-11751
A class of network decomposition switches
[AD-A024325] N77-11797
On approximating and bounding GI/M/c queues
[AD-A023975] N77-11798

R

RADAR BEACONS
Test and evaluation of the beacon processing subsystem of the Automated Radar Terminal Systems [ARTS III] all-digital tracking level system
[AD-A028514/8] N77-11025
RADAR EQUIPMENT
Phase scanned array bandwidth limitations in a wideband radar system
N77-11265
RADAR REFLECTORS
Electric field in the focal region of an offset parabolic receiving antenna
N77-11256
RADAR SCANNING
Simulation of automatic detection and track-while-scan systems for unstabilized shipboard radars
N77-11257
RADIANCY
Tests and evaluations of CLRX, the diagnosis of clear-column radiances
[AD-A023908] N77-11622
RADIATION
Inverse source problem: Eigenfunction analysis of Bojarski's integral equation
[AD-A025297] N77-11776
RADIATION ABSORPTION
Differential optoacoustic absorption detector
[NASA-CASE-NPO-13759-1] N77-11363
Radiation from a collection of absorbing resonant systems in the presence of boundaries of intense fields
N77-11828
RADIATION COUNTERS
Charge and mass identification of fission fragments
N77-11110
RADIATION DOSAGE
Radiological quality of the environment
[PB-254615/8] N77-11636
RADIATION EFFECTS
Susceptibility of UHF RF transistors to high power UHF signals, part 2
[AD-A024394] N77-11316
The effect of 1.6 GHz radiation on neurotransmitters in discrete areas of the rat brain
[AD-A023677] N77-11662
RADIATION MEASUREMENT
The status and quality of radiation measurements of water
[PB-255107/5] N77-11584
RADIATION PROTECTION
Advanced hardened antenna window materials study 4
[AD-A023944] N77-11128
RADIATION SOURCES
Radiological quality of the environment
[PB-254615/8] N77-11636
RADIATIVE RECOMBINATION
Far-infrared recombination radiation from impact-ionized shallow donors in n-type GaAs in high magnetic fields
N77-11880
RADIATIVE TRANSFER
A general formulation and some approximate methods for multi-dimensional nongray radiative transfer
N77-11338
Radiative transfer and gas dynamics in galactic X-ray sources
N77-11957
RADIO ATTENUATION
Strong impact propellants of little specific attenuation for radioelectric waves
N77-11191
RADIO COMMUNICATION
Interference problems associated with proposed expansion of the 27 MHz citizens radio service band. Part 1: Summary
[PB-254488/0] N77-11271
Study of the use of Cefly Lancer wideband data link equipment for Guardrail 2A, 4, and 5.
[AD-A025089] N77-11280
RADIO EQUIPMENT
Stress analysis of Navy VLF antenna insulators
[AD-A024054] N77-11312
RADIO FREQUENCY INTERFERENCE
Interference problems associated with proposed expansion of the 27 MHz citizens radio service band. Part 1: Summary
[PB-254488/0] N77-11271
Motor vehicle ignition radiation with respect to the SAE standard J551C
[PB-254187/8] N77-11273
RADIO RELAY SYSTEMS
Adaptive Same Frequency Repeater [SFR] study
[AD-A023928] N77-11278
RADIO TRANSMISSION
Location variability of transmission loss: Land mobile and broadcast systems
[PB-254472/4] N77-11272
RADIO WAVES
Strong impact propellants of little specific attenuation for radioelectric waves
N77-11191

Radio-frequency wave coupling and mode conversion at the lower hybrid resonance
N77-11249

RADIOACTIVE ISOTOPES
The status and quality of radiation measurements of water
[PB-255107/5] N77-11584
Linear polarization measurements on gamma rays from Pd-100, Pd-102, Pd-104 and Pd-106
N77-11958

RADIOACTIVE MATERIALS
A new atmospheric diffusion model
N77-11609
Radiological quality of the environment
[PB-254615/8] N77-11636

RADIOGRAPHY
Density measurement of copper shaped charge jet using the flash radiography — using equivalence of optical density and thickness in X ray absorption
[ISL-R-101/76] N77-11376

RADIOMETERS
Scanning radiometer for measurement of forward-scattered light to determine mean diameter of spray particles
[NASA-TM-X-3454] N77-11366
Review of the CIE photometric model and of the status of radiometric measurements
[PB-255209/9] N77-11383

RADOME MATERIALS
Study of erosion mechanisms of engineering ceramics
[AD-A025258] N77-11184

RAIN GAGES
Estimating probability of multiple occurrence of annual daily maximum rainfall
N77-11634

RAMAN SPECTRA
Development of a Raman system as a combustion diagnostic tool
[AD-A023935] N77-11140
Applications of non-intrusive instrumentation in fluid flow research — including Raman spectra, Laser Doppler Velocimeters, and electron beams; conference proceedings
[AGARD-CP-193] N77-11221
Laser Raman diagnostics of aerodynamic flows and flames
N77-11234
Local measurement and proportional density of gaseous flow by Raman anti-Stokes coherent scattering
N77-11235
Experimental investigation of coaxial turbulent jets
N77-11337

RANDOM ACCESS MEMORY
An optimal algorithm for testing random access memories
[AD-A023894] N77-11732

RANDOM LOADS
Investigation of the effects of nonhomogeneous [or nonstationary] behavior on the spectra of atmospheric turbulence
[NASA-CR-2745] N77-11034

RANDOM NOISE
Finite state equalization — bit by bit detection of the binary data sequence based on samples subject to interference and Gaussian noise
N77-11762

RANDOM NUMBERS
Random bit generator
[AD-A024019] N77-11748

RANDOM SAMPLING
Procedure for maintenance and rework process quality control based on random sampling
[AD-A024257] N77-11421
Technical Report accompanying procedure for maintenance and rework process quality control based on random sampling
[AD-A024256] N77-11422
A note on distribution-free tolerance limits
[AD-A024137] N77-11788

RANDOM VARIABLES
A canonical analysis of multiple time series
[AD-A023861] N77-11773
A Bayesian approach to two-stage sampling
[AD-A025624] N77-11796

RANGEFINDING
Development of a small solid propellant rocket motor for flexible range requirements
N77-11188

RARE GASES
Hydrogen-fueled engine
[NASA-CASE-NPO-13763-1] N77-11398

RATES [PER TIME]
Crack growth data of 2024-T3-clad as determined in Fokker report R-1764 and in NLR report TN-M2092 — noting crack growth rates in specimens tested in fatigue
[FOK-R-1814] N77-11120
Absolute rate of the reaction of C l(2P) with methane from 200-500 K
[NASA-TM-X-71221] N77-11136
Experimental and numerical studies of rate-dependent materials
N77-11429

RATS
The effect of 1.6 GHz radiation on neurotransmitters in discrete areas of the rat brain
[AD-A023677] N77-11662

RAYLEIGH SCATTERING
Rayleigh linewidth measurements in liquid helium
N77-11209

REACTION KINETICS
Project SQUID: A cooperative program of fundamental research related to jet propulsion
[AD-A024004] N77-11059
Steady-state multiplicity of catalytic reaction systems
N77-11132
The thermodynamics and kinetics of interstitial solid solutions
N77-11883

REACTOR MATERIALS
Axial xenon redistribution and power shaping in large pressurized water reactors
N77-11845

REACTOR SAFETY
Methodology development for statistical evaluation of reactor safety analyses
[PB-255408/7] N77-11550

REACTOR TECHNOLOGY
Environmental and safety aspects of alternative nuclear power technologies. Fusion power systems
[PB-255502/7] N77-11564
The contribution of nuclear technology toward the solution of energy problems
[INIS-MF-1867] N77-11565

REAL TIME OPERATION
Method of discrete modeling and its application to estimation of TF30 engine variables
[NASA-TM-X-3443] N77-11057
MULTI8, the PDP8 real-time operating system for multitasking foreground- and timesharing background operation. Part 1: Introduction to MULTI8
[MBL-1975-7] N77-11724

REATTACHED FLOW
Calculation of the flow around a swept wing, taking into account the effect of the three-dimensional boundary layer. Part 1: Wing with turbulent boundary layer
[NLR-TR-75076-U] N77-11011

RECEPTORS [PHYSIOLOGY]
Receptor contributions to steady-state sensitivity in the peripheral retina of human observers
N77-11654

RECURSIVE FUNCTIONS
Robustized recursive estimators and adaptive partition detectors
N77-11259

REDUCTION [CHEMISTRY]
Catalytic reduction of nitric oxide with carbon monoxide by rare earth oxides and noble metal catalysts
N77-11567

REELS
Tetherline system for orbiting satellites
[NASA-CASE-MFS-23564-1] N77-11079

REENTRY GUIDANCE
Effects of modifications to the space shuttle entry guidance and control systems
[NASA-TN-D-8273] N77-11087

REENTRY VEHICLES
Infrared signature modifications, volume 1
[AD-A024653] N77-11854

REFINING
The production and refining of crude oil into military fuels
[AD-A024652] N77-11207

REFLECTED WAVES
The theoretical reflectance of X-rays from optical surfaces
[NASA-TN-D-8366] N77-11853

REFRACTIVITY
An inverse method for determining small variations in propagation speed
[AD-A025296] N77-11467

REGIONAL PLANNING
The 29950 Earth Resource Technology Satellite [ERTS-A] sensor data for mineral resource sector development and regional land use survey, March - August 1976 — Bolivia
[E77-10028] N77-11491
Regional air pollution study: Quality assurance audits
[PB-255313/9] N77-11605

REGRESSION ANALYSIS
Regression using hockey stick functions
[PB-253576/3] N77-11576
Some aspects of bivariate regression subject to linear constraints — in the Bayesian and sampling theory framework
[AD-A024255] N77-11794

REGRESSION COEFFICIENTS
On estimation of regression coefficients
N77-11760

REGULATORS
Frequency domain solution of the optimum steady-state regulator problem
[OUEL-1145/76] N77-11756

REINFORCED PLASTICS
Mechanical properties of glass and Kevlar molded composites
[AD-A024196] N77-11126

REINFORCEMENT [STRUCTURES]
Bond characteristics of model reinforcement
[PB-255847/6] N77-11473

REINFORCING FIBERS
The effects of moisture on the mechanical performance of T300/graphite/glass/epoxy hybrid composites
[AD-A023668] N77-11124

RELIABILITY
A verification system for JOVIAL/J3 programs [Rugged Programming Environment: RPE/1]
[AD-A024395] N77-11730

RELIABILITY ANALYSIS
Distributed parameter sensitivity theory to solve certain reliability problems
N77-11418
Analysis of unified testing theory — reliability testing for munition components
[AD-A023872] N77-11791

RELIABILITY ENGINEERING
Small axial compressor technology, volume 1
[NASA-CR-134827-VOL-1] N77-11048
A model for predicting integrated man-machine system reliability. 2: Model validation
[AD-A023886] N77-11420

REMOTE CONTROL
An hierarchic multi-suppliers computer network of a research laboratory with two settlements — real time operation
[NLR-MP-75012-U] N77-11746

REMOTE SENSORS
Remote sensing of temperature and composition of gas plumes by infrared emission interferometry-spectroscopy
N77-11135
Potential role of remote sensing in disaster relief management
[NASA-CR-149102] N77-11502
Red River chloride remote sensing study
[NASA-CR-149189] N77-11503
Resource and environmental surveys from space with the thematic mapper in the 1980's
[NASA-CR-149191] N77-11508
The use of remote sensing devices for acquiring data for environmental management purposes. Report 2: Application of photographic remote sensors to an environmental management problem
[AD-A025616] N77-11519
Evaluation of satellites and remote sensors for atmospheric pollution measurements
[NASA-CR-144970] N77-11569
Airborne LIDAR Raps studies, February 1974 — for computerized air pollution monitoring
[PB-255886/4] N77-11601
Tests and evaluations of CLRX, the diagnosis of clear-column radiances
[AD-A023908] N77-11622

REMOTELY PILOTED VEHICLES
Development of an optical fiber video data link
[AD-A025220] N77-11027
Conceptual designs for a modular remotely piloted vehicle
[AD-A023844] N77-11035
A wind tunnel captive aircraft testing technique
[AD-A023690] N77-11037

RENDEZVOUS SPACECRAFT
Tetherline system for orbiting satellites
[NASA-CASE-MFS-23564-1] N77-11079

REPEATERS
Adaptive Same Frequency Repeater [SFR] study
[AD-A023928] N77-11278

REPRODUCTION [COPYING]
Rapid electrographic and electrophotographic processes. Lenard window for electrostatic printing tubes — in reproduction equipment
[BMFT-FB-T-76-06] N77-11299

RESEARCH AND DEVELOPMENT
Research and development for Canadian nuclear power
[AECL-5314] N77-11533
Justifications of appropriation estimates for Committee on Appropriations, fiscal year 1976
[PB-256464/9] N77-11604
Guidelines for research planning and design in task analysis
[AD-A024132] N77-11898
An analysis of the technology role in US power during the mid-range period
[AD-A024042] N77-11927

RESEARCH FACILITIES
An assessment of flow quality requirements for the compressor research facility
[AD-A023888] N77-11408
Eight-year applied optics research report
[AD-A025340] N77-11857

RESEARCH PROJECTS
Federal scientific and technical communication activities: 1975
[PB-253975/7] N77-11279
Eight-year applied optics research report
[AD-A025340] N77-11857

RESERVES
Strategic petroleum reserve
[PB-255476/4] N77-11546
RESERVOIRS
The LANDSAT satellite and flood control in New England, June 1976
[E77-10026] N77-11489
RESIDUAL STRESS
Lamination residual stresses in hybrid composites, part 1
[NASA-CR-135085] N77-11114
Wave propagation in fiber composite laminates, part 2
[NASA-CR-135086] N77-11115
RESISTORS
Thin film circuits for future applications. Part 1: Basic investigations and sputtering technique
[BMFT-FB-T-76-20] N77-11306
RESONANCE
Resonant pressure instrumentation
N77-11358
Radiation from a collection of absorbing resonant systems in the presence of boundaries of intense fields
N77-11828
RESONANT FREQUENCIES
Calculation of vibration modes and resonance frequencies of the Northrop NF-5
[NLR-TR-75050-U] N77-11450
Numerical determination of minimum mass structures with specified natural frequencies
[AD-A023655] N77-11463
RESONATORS
A new ceramic flat pack for quartz resonators
[AD-A024074] N77-11310
RESOURCE ALLOCATION
Mandatory Canadian crude oil allocation regulations
[PB-255319/6] N77-11509
RESOURCES MANAGEMENT
ERTS-B applications to Minnesota resource management
[E77-10005] N77-11485
A basis for analyzing prospective power generation in terms of environmental management and energy use
N77-11526
Strategic petroleum reserve
[PB-255476/4] N77-11546
Total energy management: A practical handbook on energy conservation and management
[PB-254683/6] N77-11554
Management auditing
[AD-A024133] N77-11899
An analysis of the technology role in US power during the mid-range period
[AD-A024042] N77-11927
RESPONSES
The effect of pre-adapting spectral stimuli on visual response
[AD-A024312] N77-11659
RETARDANTS
The influences of retarding admixtures on volume changes of concrete
[PB-254929/3] N77-11477
RETINA
Receptor contributions to steady-state sensitivity in the peripheral retina of human observers
N77-11654
REVERSED FLOW
Performance of 1.15-pressure-ratio fan stage at several rotor blade setting angles with reverse flow
[NASA-TM-X-3451] N77-11008
REYNOLDS NUMBER
On the flow quality necessary for the Large European High-Reynolds-Number Transonic Windtunnel LEHRT
[AGARD-R-644] N77-11070
Low Reynolds number entrance flows: A study of a motionless mixer
N77-11319
An experimental study of compressible turbulent boundary layer separation at high Reynolds numbers
N77-11321
RHEOLOGY
Cardiovascular, renal and respiratory effects of high intensity, intermediate duration, low frequency vibration
[AD-A025098] N77-11664
RIBBON PARACHUTES
Prediction of the drag coefficient of a 20-degree conical ribbon parachute
[NASA-CR-150056] N77-11003
RICCATI EQUATION
Integration-free interval doubling for Riccati equation solutions
[NASA-CR-149145] N77-11763
RIDING QUALITY
An experimental study for determining human discomfort response to roll vibration
[NASA-TN-D-8266] N77-11666
User evaluation of ride technology research
[NASA-CR-2746] N77-11667
RIEMANN MANIFOLD
Compact transitive isometry groups
N77-11802
RINGS [MATHEMATICS]
Even order subgroups of finite dimensional division rings
N77-11800
Higher K-theory of regular rings
N77-11804
RIVER BASINS
Use of LANDSAT data for natural resources investigation in the lower basin of Danube and Danube Delta --- Romania
[E77-10032] N77-11494
Red River chloride remote sensing study
[NASA-CR-149189] N77-11503
Designing a river basin sampling system
[PB-255022/6] N77-11593
RIVERS
Application of remote sensing techniques for the study and evaluation of natural resources in Peru
[E77-10024] N77-11487
Use of LANDSAT data for natural resources investigation in the lower basin of Danube and Danube Delta --- Romania
[E77-10032] N77-11494
ROADS
Frost insulating materials in roads
[VTI-40] N77-11917
Influence of Swedish building lime on the properties of fine grained soils for road construction
[VTI-41] N77-11918
Factors contributing to low friction between wheels and road surface
[VTI-52] N77-11919
ROBOTS
Control and trajectory optimization of a robot arm
[AD-A023669] N77-11688
ROCKET ENGINE CONTROL
Small solid propellant rockets for field use
[AGARD-CP-194] N77-11185
ROCKET ENGINE DESIGN
Development of a small solid propellant rocket motor for flexible range requirements
N77-11188
ROCKET ENGINES
Compensated control loops for a 30-cm ion thruster
[NASA-TM-X-73497] N77-11100
Long lifetime hollow cathodes for 30-cm mercury ion thrusters
[NASA-TM-X-73523] N77-11101
Cycle life testing of 8-cm mercury ion thruster cathodes
[NASA-TM-X-73526] N77-11102
Performance documentation of the engineering model 30-cm diameter thruster
[NASA-TM-X-73530] N77-11103
Sputtering phenomena of discharge chamber components in a 30-cm diameter Hg ion thruster
[NASA-TM-X-73533] N77-11104
High reliability cathode heaters for ion thrusters
[NASA-TM-X-73538] N77-11105
An interior ballistics model for a spinning rocket motor
N77-11193
ROCKET PROPELLANTS
New methods for the measurement of relative ignitability and ignition efficiency
[AD-A023862] N77-11206
ROCKETS
Military rocket aircraft: Inherent constraints and their uses
N77-11186
ROCKWELL HARDNESS
Hot hardness of nickel-rich nickel-chromium-aluminum alloys
[NASA-TM-X-3429] N77-11155
RODS
Lateral vibrations of an extending rod
[UTIAS-TN-202] N77-11438
ROLL
An experimental study for determining human discomfort response to roll vibration
[NASA-TN-D-8266] N77-11666
ROLLER BEARINGS
Bearing restoration by grinding
[NASA-CR-149188] N77-11404
ROOT-MEAN-SQUARE ERRORS
RM2: rms error comparisons
[NASA-CR-149150] N77-11717
ROTATING BODIES
An interior ballistics model for a spinning rocket motor
N77-11193
ROTATING MATTER
Composition and equation of state of thermally dissociated matter and mass and stability of rigidly rotating relativistic polytropes
N77-11843
ROTOR BLADES [TURBOMACHINERY]
Performance of 1.15-pressure-ratio fan stage at several rotor blade setting angles with reverse flow
[NASA-TM-X-3451] N77-11008
RUBIDIUM
Hartree-Fock energy curves, for BrH[+][X[P2]I], KrH[+][X1 sigma [+]], and RbH[+][X 2 sigma [+]]
[UCRL-51738] N77-11831
RUBY LASERS
Reduction of target detectability by laser protective materials
[AD-A024383] N77-11682
RUMANIA
Use of LANDSAT data for natural resources investigation in the lower basin of Danube and Danube Delta --- Romania
[E77-10032] N77-11494
RUNWAYS
Design and construction of airport pavements on expansive soils
[AD-A028094/1] N77-11437
RURAL AREAS
A preliminary review of current practices and trends in rural telecommunications development and recommendations for future development
[PB-254366/8] N77-11274
RYDBERG SERIES
Collisional ionization of xenon atoms in well defined high Rydberg states
N77-11826

S

S-2 AIRCRAFT
Catapult launch fatigue investigation of the model S-2 E airplane
[AD-A024071] N77-11038
SAFETY FACTORS
Safe use of the P-3 strobe lamp
[AD-A024036] N77-11658
SAFETY MANAGEMENT
Report of the Army Scientific Advisory Panel Ad Hoc Group on fire-safe fuels
[AD-A023763] N77-11208
Vocabulary of aerospace safety terms pertaining to cryogenic safety, fires, explosions, and structure failure
[NASA-TM-X-73521] N77-11901
SALINITY
Spectral reflectance signatures of coastal pollutants --- Delaware
[E77-10011] N77-11486
Red River chloride remote sensing study
[NASA-CR-149189] N77-11503
SAMARIUM COMPOUNDS
Magnetoelastic interactions in SmCo5
N77-11810
SAMPLING
Designing a river basin sampling system
[PB-255022/6] N77-11593
Augmenting Lehman alternatives
[AD-A023789] N77-11789
A Bayesian approach to two-stage sampling
[AD-A025624] N77-11796
SAN JUAN MOUNTAINS [CO]
Ecological impacts of snowpack augmentation in the San Juan Mountains of Colorado
[PB-255012/7] N77-11514
SANDWICH STRUCTURES
Certification of the replacement of glass fabric per mat. spec. 5.670/1, with glass fabric per mat. spec. 5.670 in the F27 plastic sandwich wing-and-stabilizer-leading edges --- noting shear strength and sandwich stiffness
[FOK-R-1876] N77-11122
Local instability of sandwich plates --- wrinkling problems
N77-11426
SATELLITE OBSERVATION
Evaluation of satellites and remote sensors for atmospheric pollution measurements
[NASA-CR-144970] N77-11569
Observation of the galactic hard X-ray background from the OSO-7 satellite
N77-11963
SATELLITE ORBITS
Computational results of the NISLAP and AIM-LASER programs for satellite position predictions --- noting program accuracy and perturbing forces
[VTH-212] N77-11080
LANDSAT 2: Cumulative Non-US Standard Catalog, 1975 - 1976 --- LANDSAT imagery for January 1975 through January 1976
[NASA-TM-X-74212] N77-11481
LANDSAT 2: Cumulative US Standard Catalog, 1975 - 1976 --- LANDSAT imagery for January 1975 through January 1976
[NASA-TM-X-74217] N77-11482
LANDSAT: Non-US Standard Catalog, 1 - 30 June 1976 --- LANDSAT imagery for June 1976
[GSFC/LN-76/006] N77-11504
LANDSAT: US Standard Catalog, 1 - 31 July 1976 --- LANDSAT imagery for July, 1976
[NASA-TM-X-74213] N77-11507
LANDSAT: Non-US Standard Catalog --- LANDSAT imagery for July 1976
[NASA-TM-X-74214] N77-11521
LANDSAT: Non-US Standard Catalog --- LANDSAT imagery for August 1976
[NASA-TM-X-74215] N77-11522

LANDSAT: US Standard catalog --- LANDSAT imagery for August 1976
[NASA-TM-X-74216] N77-11523

SATELLITE PERTURBATION
Analysis of the perturbed motion of asymmetric, spinning spacecraft
[NLR-TR-75043-U] N77-11097

SATELLITE POWER TRANSMISSION [TO EARTH]
Space station systems analysis study. Part 1, volume 1: Executive study
[NASA-CR-151102] N77-11084
Space station systems analysis study. Part 1, volume 2: Technical report
[NASA-CR-151103] N77-11085

SATELLITE ROTATION
Analysis of the perturbed motion of asymmetric, spinning spacecraft
[NLR-TR-75043-U] N77-11097

SATELLITE TELEVISION
Analysis of economics of a TV broadcasting satellite for additional nationwide TV programs
[BMFT-FB-T-76-05] N77-11270

SATELLITE-BORNE PHOTOGRAPHY
LANDSAT 2: Cumulative Non-US Standard Catalog, 1975 - 1976 --- LANDSAT imagery for January 1975 through January 1976
[NASA-TM-X-74212] N77-11481
LANDSAT 2: Cumulative US Standard Catalog, 1975 - 1976 --- LANDSAT imagery for January 1975 through January 1976
[NASA-TM-X-74217] N77-11482
LANDSAT: Non-US Standard Catalog, 1 - 30 June 1976 --- LANDSAT imagery for June 1976
[GSFC/LN-76/006] N77-11504
LANDSAT: US Standard Catalog, 1 - 31 July 1976 --- LANDSAT imagery for July, 1976
[NASA-TM-X-74213] N77-11507
LANDSAT: Non-US Standard Catalog --- LANDSAT imagery for July 1976
[NASA-TM-X-74214] N77-11521
LANDSAT: Non-US Standard Catalog --- LANDSAT imagery for August 1976
[NASA-TM-X-74215] N77-11522
LANDSAT: US Standard catalog --- LANDSAT imagery for August 1976
[NASA-TM-X-74216] N77-11523

SCATTERING
Single scattering particle laser Doppler measurements of turbulence
N77-11230
An inverse method for determining small variations in propagation speed
[AD-A025296] N77-11467

SCATTERING AMPLITUDE
The renormalisation group and scaling at high energy in Yukawa field theory
N77-11842

SCATTERING CROSS SECTIONS
Tabulation of hybrid theory calculated e-N2 vibrational and rotational cross sections
[NASA-TN-D-8347] N77-11830

SCATTERING FUNCTIONS
Zeros of the multiparticle generating function in hadronic scattering models
N77-11825

SCHLIEREN PHOTOGRAPHY
Investigation of a V-gutter stabilized flame by laser anemometry and schlieren photography
N77-11246

SCHOOLS
The Chicago Project: Evaluation and testing of three types of energy audit processes for school buildings
[PB-255321/2] N77-11555

SCIENTISTS
An analysis of the technology role in US power during the mid-range period
[AD-A024042] N77-11927

SEA ICE
Revised aircraft load curves and vehicle ice-thickness tables for annual ice sheet operations near McMurdo, Antarctica
[AD-A024051] N77-11461

SEA STATES
Time series analysis applied to data from a single ocean wave gauge
[AD-A023821] N77-11769

SEALERS
Rigid pavement joints and sealants study
[PB-254806/3] N77-11469

SEALS [STOPPERS]
Nonaxisymmetric incompressible hydrostatic pressure effects in radial face seals
[NASA-TN-D-8343] N77-11401

SEATS
Conference on the Development of Fire-Resistant Aircraft Passenger Seats
[NASA-TM-X-73144] N77-11111
Psycho-physiological and physio-chemical assessment of acceleration induced changes in humans positioned in various seatback angle configurations
N77-11647
Centrifuge assessment of a reclining seat
N77-11648

SECONDARY FLOW
Secondary flow in axisymmetric compressors
[NASA-TT-F-15497] N77-11009

SEDIMENTS
Sediment studies in Back River Estuary, Baltimore, Maryland
[PB-255584/5] N77-11594

SEISMIC WAVES
On the theory of the electromagnetic seismograph -- - parametrization for earth movement magnification
[KNMI-102-95] N77-11619

SEISMOGRAPHS
An analysis of inertial seismometer-galvanometer combinations
[PB-254475/7] N77-11379
On the theory of the electromagnetic seismograph -- - parametrization for earth movement magnification
[KNMI-102-95] N77-11619

SELF PROPAGATION
Diffusion in transition metals and alloys and selective adsorption and hydrogen embrittlement
N77-11144

SEMICONDUCTING FILMS
Semiconductor-electrolyte photovoltaic energy converter
[PB-252837/0] N77-11548

SEMICONDUCTOR DEVICES
Programmable data collection platform study
[NASA-CR-144819] N77-11086

SEMICONDUCTOR JUNCTIONS
Disturbance rejection and two classes of multivariable PI controllers with application to turbine-generator control
N77-11396
Applied research on II-VI compound
[PB-254637/2] N77-11547

SENSITIVITY
Distributed parameter sensitivity theory to solve certain reliability problems
N77-11418

SEPARATED FLOW
Viscous interaction with separation in transonic flow
[NASA-TT-F-17187] N77-10997
Controlled and uncontrolled flow separation in three dimensions
[LR-591] N77-10999
Qualitative and quantitative flow field visualization utilizing laser-induced fluorescence
N77-11237
Fluid Dynamics Panel Symposium on Flow Separation
[AGARD-AR-98] N77-11357

SEPARATION
Separations of multicomponent mixtures via thermal parametric pumping
N77-11328

SEQUENCING
An HVDC breaker with sequential switching
N77-11286

SEQUENTIAL COMPUTERS
Fast sequential decoding and a new complete decoding algorithm
N77-11705
Sequential partition detectors with applications
N77-11781

SERIES EXPANSION
Contributions to WKB theory
N77-11891

SET THEORY
On discrete-time polynomial systems
[AD-A024481] N77-11774
Critical cutsets of graphs and canonical facets of set packing polytopes
[AD-A023854] N77-11806

SETTLING
Dynamics of the continuous settling of discrete-particle slurries
N77-11134

SEWAGE TREATMENT
Aerobic biological treatment of a colloidal wastewater
N77-11568
Heat treatment of refuse for increasing anaerobic biodegradability
[PB-252924/6] N77-11577

SHALE OIL
The production and refining of crude oil into military fuels
[AD-A024652] N77-11207

SHAPED CHARGES
Density measurement of copper shaped charge jet using the flash radiography --- using equivalence of optical density and thickness in X ray absorption
[ISL-R-101/76] N77-11376

SHEAR FLOW
Some effects of the shearing and veering environmental flow on the internal dynamics and structure of a severe thunderstorm during its mature stage
N77-11633

SHEAR LAYERS
Modeling dynamic processes in planetary atmospheres. Part 1: Apparatus for studying shear flow stability in spherical layers, preliminary results
[NASA-TT-F-17262] N77-11951

SHEAR PROPERTIES
Simple thickness modes and shear correction coefficients for viscoelastic Timoshenko beams
[AD-A023771] N77-11125

SHEAR STRENGTH
Tables for determining isotropic and anisotropic shear strengths from consolidated undrained triaxial compression tests
[AD-A024025] N77-11625

SHEAR STRESS
An analysis of data taken from the impact viscometer at Imperial College
[AD-A023143] N77-11178
Investigation of performance limits in axial groove heat pipes
[NASA-CR-137912] N77-11340
Stiffness and stress analysis of discretely attached corrugated shear webs with quasi-sinusoidal corrugations
N77-11434

SHELL STABILITY
On the elastic stability of shells
[NASA-CR-145088] N77-11440

SHELLS [STRUCTURAL FORMS]
Steady state response of shell structures
N77-11428

SHELTERS
The Chicago Project: Evaluation and testing of three types of energy audit processes for school buildings
[PB-255321/2] N77-11555
MIUS systems analysis: Effects of unfavorable meteorological conditions and building configurations on air quality
[ONRL/HUD/MIUS-29-ADD-2] N77-11571

SHIP HULLS
A theoretical prediction technique for lateral hydrodynamic loads on sidewalks of surface-effects ships
[AD-A024510] N77-11220

SHIPS
Simulation of automatic detection and track-while-scan systems for unstabilized shipboard radars
N77-11257
An evaluation of a fuel-soluble organoboron biocide for control of sulfate-reducing bacteria in shipboard fuel tanks
[AD-A024017] N77-11643

SHOCK RESISTANCE
Behavior of various condensated explosives to shock waves calibrated in intensity and duration --- using explosive lateral projection technique
[ISL-CO-211/75] N77-11204

SHOCK WAVE INTERACTION
Behavior of various condensated explosives to shock waves calibrated in intensity and duration --- using explosive lateral projection technique
[ISL-CO-211/75] N77-11204
The application of a laser anemometer to the investigation of shock-wave boundary-layer interactions
N77-11226
Plane shock waves in quantum gases at very low temperatures
N77-11867

SHOCK WAVE PROFILES
Behavior of various condensated explosives to shock waves calibrated in intensity and duration --- using explosive lateral projection technique
[ISL-CO-211/75] N77-11204

SHOCK WAVES
Theory of shock structure in a Maxwell gas based on the Chapman-Enskog development through Super-Super-Burnett order
N77-11324
Comparison of data from two shock wave turbulent boundary layer interaction experiments
[AD-A024520] N77-11352

SHORT TAKEOFF AIRCRAFT
A flight investigation of piloting techniques and crosswind limitations during visual STOL-type landing operations
[NASA-TN-D-8284] N77-11001
Simulation of an automatically-controlled STOL aircraft in a microwave landing system multipath environment
[NASA-TM-X-73154] N77-11063
OTW noise correlation for several nozzle/wing geometries using a 5:1 slot nozzle with external deflectors
[NASA-TM-X-73529] N77-11815

SHOT PEENING
Shot peening procedures for helical compression springs
[AD-A023758] N77-11415

SIGNAL DETECTION
Fringe mode fluorescence velocimetry
N77-11240
S2 probability and CNV [Contingent Negative Variation] --- signal detection task and selective reaction time task
[IZF-1975-11] N77-11668

SIGNAL ENCODING
Optimal linear coding for a multichannel system
N77-11251

SIGNAL FLOW GRAPHS
Transient behavior of an adaptive array
N77-11250
SIGNAL PROCESSING
Analysis of the ouput data of a laser Doppler velocimeter
N77-11229
Flow field in the wake of a blunt body by laser Doppler anemometry
N77-11245
Finite wordlength in digital signal processing
N77-11255
Applications of satellite technology for regional organizations [Project ASTRO]
[NASA-CR-149184] N77-11267
SIGNAL TO NOISE RATIOS
Fringe mode fluorescence velocimetry
N77-11240
Sequential partition detectors with applications
N77-11781
SILANES
New propellants for tactical weapons: Silanes
N77-11190
SILICON
Properties of Cr-SiO2-n Si tunnel diodes
N77-11291
Industrial development of silicon solar cells
[NASA-TT-F-17139] N77-11528
SILICON DIOXIDE
Advanced hardened antenna window materials study 4
[AD-A023944] N77-11128
Properties of Cr-SiO2-n Si tunnel diodes
N77-11291
A photocurrent spectroscopic method for determination of trapping state distributions in silicon dioxide thin films
N77-11875
One-electron energy bands of silicon dioxide in the ideal beta cristobalite structure
N77-11882
SINGLE CRYSTALS
Magnetoelastic interactions in SmCo5
N77-11810
Pulse NMR in solids: Chemical shift, lead fluoride and thorium hydride
N77-11873
SIZING [SURFACE TREATMENT]
Preliminary sizing and performance evaluation of supersonic cruise aircraft
[NASA-TM-X-73936] N77-11031
SKIN FRICTION
Systematic study of error sources in supersonic skin-friction balance measurements
[NASA-TN-D-8291] N77-11339
SLABS
An invariant imbedding, orders-of-scattering approach to particle transport in a slab
[AD-A024155] N77-11832
SLENDER BODIES
Nonlinear periodic response of a slender beam-column
N77-11435
SLOTS
Investigation of slot cooling for high-speed aircraft
[AD-A024316] N77-11061
OTW noise correlation for several nozzle/wing geometries using a 5:1 slot nozzle with external deflectors
[NASA-TM-X-73529] N77-11815
SLOTTED WIND TUNNELS
The effect of finite test section length on wall interference in 2-D ventilated wind tunnels
[NLR-MP-75036-U] N77-11071
SLURRIES
Dynamics of the continuous settling of discrete-particle slurries
N77-11134
High energy composite double base solid propellants
N77-11189
SNOW
Development of remote sensing technology in New Zealand, part 1. Seismotectonic, structural, volcanologic and geomorphic study of New Zealand, part 2. Indigenous forest assessment, part 3. Mapping land use and environmental studies in New Zealand, Part 4. New Zealand forest service LANDSAT projects, part 5. Geographical applications in LANDSAT mapping: Landuse mapping and environmental studies, part 6
[E77-10040] N77-11500
SNOW COVER
Ecological impacts of snowpack augmentation in the San Juan Mountains of Colorado
[PB-255012/7] N77-11514
SOCIAL FACTORS
Benefit assessment of NASA space technology goals
[NASA-CR-149192] N77-11914
SODIUM COMPOUNDS
Ionic conductivity in the sodium gallates
N77-11872
SODIUM ISOTOPES
High spin states in Mg-26 and Na-23 populated by heavy ion reactions
N77-11838
SOIL MAPPING
Inferential techniques for soil depth determinations. Part 1: Coleogyne ramosissima Torr. [Black-brush]
[AD-A024355] N77-11627
SOIL MECHANICS
Development of mathematical model for pneumatic tire-soil interaction in layered soils
[AD-A024162] N77-11416
Validation of soil stabilization index system with manual development
[AD-A024549] N77-11456
Tables for determining isotropic and anisotropic shear strengths from consolidated undrained triaxial compression tests
[AD-A024025] N77-11625
SOIL SCIENCE
Optimal management of the subsurface environment: Parameter identification
[PB-255648/8] N77-11921
SOILS
Influence of Swedish building lime on the properties of fine grained soils for road construction
[VTI-41] N77-11918
SOLAR ACTIVITY
Initiation of non-tropical thunderstorms by solar activity
[NASA-TM-X-71222] N77-11635
SOLAR ARRAYS
Solar power array for the concentration of energy. Task 2: Modifications to a specular photometer
[COO-2699-3] N77-11538
SOLAR ATMOSPHERE
Nonrelativistic electron stream propagation in the solar atmosphere and solar wind: Type 3 bursts
N77-11952
SOLAR CELLS
Industrial development of silicon solar cells
[NASA-TT-F-17139] N77-11528
Flexible, FEP-Teflon covered solar cell module development
[NASA-CR-135109] N77-11531
Applied research on II-VI compound
[PB-254637/2] N77-11547
Semiconductor-electrolyte photovoltaic energy converter
[PB-252837/0] N77-11548
SOLAR COLLECTORS
Optimized selective coatings for solar collectors
[NASA-TM-X-73498] N77-11529
Evaluation of flat-plate collector efficiency under controlled conditions in a solar simulator
[NASA-TM-X-73520] N77-11530
Solar radiation availability to various collector geometries: A preliminary study
[SAND-76-0009] N77-11537
Solar power array for the concentration of energy. Task 2: Modifications to a specular photometer
[COO-2699-3] N77-11538
Attic concentrator type solar energy collector
[BNL-50493] N77-11539
SOLAR CORONA
A comparison of the composition of new and evolved comets
[NASA-TM-X-71215] N77-11945
The Hale solar sector boundary
[NASA-CR-149173] N77-11955
SOLAR CYCLES
Three-dimensional structure of the extended solar magnetic field and the sunspot cycle variation in cosmic ray intensity
[NASA-CR-149174] N77-11956
SOLAR ENERGY
Solar radiation availability to various collector geometries: A preliminary study
[SAND-76-0009] N77-11537
Nuclear reactions on the sun
[NASA-TT-F-17267] N77-11954
SOLAR ENERGY CONVERSION
National program for solar heating and cooling [residential and commercial applications]
[ERDA-23A] N77-11540
Applied research on II-VI compound
[PB-254637/2] N77-11547
Semiconductor-electrolyte photovoltaic energy converter
[PB-252837/0] N77-11548
SOLAR FLARES
Nuclear reactions on the sun
[NASA-TT-F-17267] N77-11954
SOLAR HEATING
Commercial building unitary heat pump system with solar heating
[PB-255488/9] N77-11551
SOLAR MAGNETIC FIELD
The Hale solar sector boundary
[NASA-CR-149173] N77-11955
Three-dimensional structure of the extended solar magnetic field and the sunspot cycle variation in cosmic ray intensity
[NASA-CR-149174] N77-11956
SOLAR ORBITS
Radio observations of interplanetary magnetic field structures out of the ecliptic
[NASA-TM-X-71223] N77-11947
SOLAR PHYSICS
Neutrino astrophysics
[NASA-TT-F-17249] N77-11946
SOLAR RADIO BURSTS
Radio observations of interplanetary magnetic field structures out of the ecliptic
[NASA-TM-X-71223] N77-11947
SOLAR SIMULATORS
Evaluation of flat-plate collector efficiency under controlled conditions in a solar simulator
[NASA-TM-X-73520] N77-11530
SOLAR WIND
Nonrelativistic electron stream propagation in the solar atmosphere and solar wind: Type 3 bursts
N77-11952
Solar wind induced currents in the atmospheres of non-magnetic planets
N77-11953
A quasi-linear kinetic equation for cosmic rays in the interplanetary medium
[AD-A023849] N77-11966
SOLID PROPELLANT IGNITION
The measurement of igniter heat flux in solid propellant rocket motors
N77-11192
Simple determination of the mechanical behavior of double base rocket propellants under high loading rates
N77-11195
SOLID PROPELLANT ROCKET ENGINES
Analytical prediction of motor component vibrations driven by acoustic combustion instability
[AD-A025261] N77-11109
Small solid propellant rockets for field use
[AGARD-CP-194] N77-11185
Specifications of the propulsion systems for anti-tank rockets
N77-11187
Development of a small solid propellant rocket motor for flexible range requirements
N77-11188
The measurement of igniter heat flux in solid propellant rocket motors
N77-11192
Ultrasonic inspection of seat-back ejection rocket motors
[AD-A024379] N77-11385
SOLID PROPELLANTS
Determining the shelflife of solid propellants
N77-11194
SOLID SOLUTIONS
The thermodynamics and kinetics of interstitial solid solutions
N77-11883
SOLID WASTES
Study of the feasibility of federal procurement of fuels produced from solid wastes
[PB-255695/9] N77-11513
Optimal productivity for solid waste collection: A systems approach
N77-11913
SOLIDIFICATION
Directionally solidified in situ metal matrix composites, part 1 — superalloys for manufacture of turbine blades
[AD-A024217] N77-11162
Development of directionally solidified eutectic nickel and cobalt alloys — for turbine blades
[AD-A024420] N77-11165
SOLIDIFIED GASES
Inelastic neutron scattering in solid neon at high pressure
N77-11829
SOLIDS
Advanced concepts of microwave generation and control in solids
[AD-A023950] N77-11311
SOLUTIONS
Separations of multicomponent mixtures via thermal parametric pumping
N77-11328
SOMMERFELD APPROXIMATION
Analysis of arbitrarily oriented thin wire antenna arrays over imperfect ground planes
N77-11254
SONAR
Scattering from large planar gratings of compliant cylindrical shells
[AD-A025279] N77-11820
SONIC BOOMS
Study of metabolic response variation to an acoustic aggression — metabolic recuperation after sonic boom N wave exposure
[ISL-R-120/75] N77-11641
Statistical model of sonic boom structural damage
[AD-A028512/2] N77-11818
Study of acoustic wave propagation in the atmosphere. Feasibility of an experimental study in the ISL sonic boom generator
[ISL-4/74] N77-11819

SOUND GENERATORS
Study of metabolic response variation to an acoustic aggression --- metabolic recuperation after sonic boom N wave exposure
[ISL-R-120/75] N77-11641
Study of acoustic wave propagation in the atmosphere. Feasibility of an experimental study in the ISL sonic boom generator
[ISL-4/74] N77-11819
SOUND PRESSURE
Influence of the peak pressure and duration of impulse noise (gun fire) on the hearing of the guinea pig
[ISL-R-109/75] N77-11639
SOUND TRANSMISSION
Measurement and prediction of sound attenuation by buildings using acoustic modeling techniques
N77-11814
SOUND WAVES
On the convection limited self-sustained acoustic vibrations in a closed cylindrical chamber
N77-11359
Acoustic emission testing for structural applications
[AD-A024064] N77-11460
Mathematical models of acoustic and acoustic-gravity wave propagation in fluids with height-dependent sound velocities
N77-11813
Study of acoustic wave propagation in the atmosphere. Feasibility of an experimental study in the ISL sonic boom generator
[ISL-4/74] N77-11819
SOUNDING
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 2: Scientific objectives and passive sounder instruments
[ESA-CR[P]-836-VOL-2] N77-11088
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 3: Accommodation of instruments and packages on Spacelab
[ESA-CR[P]-836-VOL-3] N77-11089
SOUTH AMERICA
Regional seminar on a system of standardization and metrology for Latin America
[PB-254469/0] N77-11214
SOVIET SPACECRAFT
Space launches and finishes
[NASA-TT-F-17278] N77-11076
SPACE EXPLORATION
Space is for man
[NASA-TT-F-16254] N77-11075
SPACE FLIGHT TRAINING
Navigation input to level C OFT navigation functional subsystem software requirements (rendezvous onorbit-2)
[NASA-CR-151007] N77-11077
SPACE NAVIGATION
Navigation input to level C OFT navigation functional subsystem software requirements (rendezvous onorbit-2)
[NASA-CR-151007] N77-11077
Description of the universal program for calculating the navigational information on the location of an artificial earth satellite
[NASA-TT-F-17273] N77-11093
SPACE PROGRAMS
Cost-benefit analysis of space technology
[NASA-TM-X-3453] N77-11908
SPACE RENDEZVOUS
Parametric study of predictor accuracy impact on OFT rendezvous targeting
[NASA-CR-151094] N77-11078
SPACE SHUTTLE BOOSTERS
Heat-transfer distributions on a 0.013-scale shuttle solid rocket booster at Mach 3.70 and angles of attack from 0 deg to 180 deg
[NASA-TM-X-3417] N77-10995
Aerodynamic characteristics of a 0.00563 scale 142-inch diameter solid rocket booster [MSFC model 449 and 480] with side mounted stings in the NASA/MSFC 14-inch trisonic wind tunnel [SA14FA]
[NASA-CR-147645] N77-11000
An investigation of the aerodynamic characteristics of a 0.00548 scale model [model no. 486] of the space shuttle 146-inch diameter solid rocket booster at angels of attack from 113 deg to 180 deg in the AEDC PWT 4-foot transonic wind tunnel [SA16F]
[NASA-CR-147648] N77-11090
SPACE SHUTTLE ORBITERS
Effects of modifications to the space shuttle entry guidance and control systems
[NASA-TN-D-8273] N77-11087
Space shuttle contamination due to backflow from control motor exhaust
[NASA-CR-150054] N77-11092
Heat-transfer tests on the Rockwell International space shuttle orbiter with boundary-layer trips [OH-54]
[AD-A024553] N77-11098
SPACE SHUTTLES
The Langley thermal protection system test facility: A description including design operating boundaries
[NASA-TM-X-73973] N77-11067
Detailed design specification for the ALT Shuttle Information Extraction Subsystem [SIES]
[NASA-CR-151097] N77-11091
Crew training and support activities
[GPO-75-984] N77-11678
SPACE STATIONS
Space station systems analysis study. Part 1, volume 3: Appendices. Book 1: Objective data
[NASA-CR-151104] N77-11083
SPACE SUITS
Development and fabrication of an advanced liquid cooling garment
[NASA-CR-137974] N77-11673
SPACE-TIME FUNCTIONS
The time-of-flight laser anemometer
N77-11243
SPACEBORNE ASTRONOMY
Interstellar space: The astrochemist's laboratory
N77-11941
SPACEBORNE PHOTOGRAPHY
Evaluation of a large format image tube camera for the shuttle sortie mission
[NASA-CR-149093] N77-11362
SPACECRAFT
Vibration of a flexible spacecraft with momentum exchange controllers
[NASA-CR-150058] N77-11096
SPACECRAFT CABIN ATMOSPHERES
Evaluation of a spacecraft nitrogen generator
[NASA-CR-137930] N77-11672
SPACECRAFT CONTROL
Vibration of a flexible spacecraft with momentum exchange controllers
N77-11095
SPACECRAFT LANDING
Detailed design specification for the ALT Shuttle Information Extraction Subsystem [SIES]
[NASA-CR-151097] N77-11091
SPACECRAFT LAUNCHING
Space launches and finishes
[NASA-TT-F-17278] N77-11076
SPACECRAFT LUBRICATION
Lubrication of bearings in vacuum. Examination of life-tested bearings from MSDS Ltd --- lead and grease lubricants
[T[F]S/128] N77-11407
SPACECRAFT MOTION
Nuclear-powered Hysat spacecraft: Comparative design study
[ERDA-SNS-3063-8] N77-11108
SPACECRAFT POWER SUPPLIES
Test program for transmitter experiment package and heat pipe system for the communications technology satellite
[NASA-TM-X-3455] N77-11268
SPACECRAFT PROPULSION
Electron bombardment propulsion system characteristics for large space systems
[NASA-TM-X-73554] N77-11106
SPACECREWS
Crew training and support activities
[GPO-75-984] N77-11678
SPACELAB
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 2: Scientific objectives and passive sounder instruments
[ESA-CR[P]-836-VOL-2] N77-11088
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 3: Accommodation of instruments and packages on Spacelab
[ESA-CR[P]-836-VOL-3] N77-11089
SPACING
On the logarithms of high order spacings
[AD-A023716] N77-11770
SPAIN
Thematic mapping, land use, geological structure and water resources in central Spain --- north of Madrid
[E77-10034] N77-11495
SPATIAL DISTRIBUTION
The measurement of spatial vorticity distributions using hot-wire anemometry techniques
[AD-A024161] N77-11014
SPECIFIC HEAT
Effect of oxygen-catalyzed nuclear spin conversion on the low temperature heat capacity of methane
[LBL-4149] N77-11203
SPECTRAL REFLECTANCE
A spectral reflectance estimation technique using multispectral data from the Viking lander camera
[NASA-TN-D-8292] N77-11099
SPECTRAL SIGNATURES
Spectral reflectance signatures of coastal pollutants --- Delaware
[E77-10011] N77-11486
Infrared signature modifications, volume 1
[AD-A024653] N77-11854
SPECTROPHOTOMETERS
Differential optoacoustic absorption detector
[NASA-CASE-NPO-13759-1] N77-11363
Modification of an NBS reference spectrophotometer
[PB-255539/9] N77-11381
SPECTROSCOPIC ANALYSIS
Laser induced fluorescence as a spectroscopic tool
N77-11131
Ellipsometric spectroscopic study of breakdown of Fe-Cr and Fe-Cr-Mo alloys
[PB-255203/2] N77-11170
SPECTRUM ANALYSIS
The eigenvalue spectrum of the Orr-Sommerfeld problem
[NASA-TR-R-469] N77-11344
Data acquisition and processing system for spectral analysis of the temporal velocity variations in a gas flow --- using laser anemometry
[ISL-R-127/75] N77-11373
Observations of Jupiter with a Hadamard transform spectrometer
[AD-A025273] N77-11939
SPHERES
A shooting method for the solution of a discrete Poisson equation on the surface of a sphere
[AD-A024158] N77-11775
SPIN
High spin states in Mg-26 and Na-23 populated by heavy ion reactions
N77-11838
SPIN DYNAMICS
Torsion and the geometry of spin
N77-11808
SPLINE FUNCTIONS
A spectral reflectance estimation technique using multispectral data from the Viking lander camera
[NASA-TN-D-8292] N77-11099
SPREAD F
Nonlinear equatorial spread F
[AD-A024440] N77-11623
SPRINGS [ELASTIC]
Shot peening procedures for helical compression springs
[AD-A023758] N77-11415
SPUTTERING
Sputtering phenomena of discharge chamber components in a 30-cm diameter Hg ion thruster
[NASA-TM-X-73533] N77-11104
A theory of ion sputtering --- from metals and semimetals
N77-11143
An experimental and analytical study of the sputtering phenomena
N77-11336
SQUID PROJECT
Project SQUID: A cooperative program of fundamental research related to jet propulsion
[AD-A024004] N77-11059
STABILITY
New methods for improving the stability of power diodes
[BMFT-FB-T-76-09] N77-11300
STABILITY TESTS
On the elastic stability of shells
[NASA-CR-145088] N77-11440
STABILIZATION
Tetherline system for orbiting satellites
[NASA-CASE-MFS-23564-1] N77-11079
STABILIZERS [FLUID DYNAMICS]
Development of a graphite horizontal stabilizer
[AD-A023767] N77-11036
STAINLESS STEELS
Electron-microscopical studies of passive films on stainless steels
[PB-255190/1] N77-11168
STANDARDIZATION
Report to AID on a Phillipines survey on standardization and measurement services
[PB-255803/9] N77-11216
STANDARDS
The national measurement system for surface finish
[PB-255809/6] N77-11217
Modification of an NBS reference spectrophotometer
[PB-255539/9] N77-11381
STARS
A study of the 6180 angstrom diffuse interstellar band
N77-11942
STATE VECTORS
Parametric study of predictor accuracy impact on OFT rendezvous targeting
[NASA-CR-151094] N77-11078
STATIC LOADS
Lamination residual stresses in hybrid composites, part 1
[NASA-CR-135085] N77-11114
STATIC TESTS
Macroscopic study of time unsteady noise of an aircraft engine during static tests
[NASA-TM-X-73556] N77-11052
STATISTICAL ANALYSIS
Methodology development for statistical evaluation of reactor safety analyses
[PB-255408/7] N77-11550
Robust statistical techniques in pattern recognition: Gray-level and edge detection
N77-11753
Mathematical statistics and probability: Stochastic processes
[AD-A024082] N77-11787
The influence of data order on the Lieberman-Ross method
[AD-A024518] N77-11792
STATISTICAL TESTS
On the logarithms of high order spacings
[AD-A023716] N77-11770

Analysis of unified testing theory — reliability testing for munition components
[AD-A023872] N77-11791

STATISTICS
The census and transportation planning: Survey of evaluations and recommendations as to the usefulness of the 1970 census data in urban transportation planning
[PB-254802/2] N77-11924

STATOR BLADES
Two-dimensional cold-air cascade study of a film-cooled turbine stator blade. 3: Effect of hole size on single-row and multirow ejection
[NASA-TM-X-3442] N77-11007

STEADY STATE
Steady-state multiplicity of catalytic reaction systems
N77-11132

Steady state response of shell structures
N77-11428

Frequency domain solution of the optimum steady-state regulator problem
[OUEL-1145/76] N77-11756

STEELS
Study of variables affecting lamellar tearing susceptibility of steels
N77-11152

Steel from urban waste
[PB-255441/8] N77-11167

Computer-aided design and manufacturing for extrusion of aluminum, titanium, and steel structural parts [phase 1]
[AD-A023946] N77-11171

Behavior of steel fragments on thin Duralumin targets. Oblique incidence. Multiple targets
[ISL-R-112/75] N77-11406

The development of steel plate for offshore structures
[PB-254195/1] N77-11453

Bond characteristics of model reinforcement
[PB-255847/6] N77-11473

Characterization and evaluation of wastewater sources United States Steel Corporation, Homestead wheel and axle plant, McKees Rocks, Pennsylvania, August 21-28, 1975
[PB-255593/6] N77-11586

Characterization and evaluation of wastewater sources United States Steel Corporation, Duquesne plant, Pittsburgh, Pennsylvania, February 26 - March 6, 1976
[PB-255594/4] N77-11587

STEEPEST DESCENT METHOD
Some iterative procedures to obtain nonlinear least squares estimates
[AD-A024437] N77-11768

STELLAR MOTIONS
Star catalogues and their significance to geodesy of the 1980's
[AD-A024156] N77-11938

STEREOPHOTOGRAPHY
Some properties of sources used in hypervelocity holography — coherent light sources
[ISL-CO-217/75] N77-11369

STEREOSCOPY
AS-11B-X automated stereomapper
[AD-A025428] N77-11524

STOCHASTIC PROCESSES
The application of doubly stochastic Poisson process estimation techniques to optical communication through log-normal fading channels
N77-11782

Stochastic multistage linear differential game with decision-time constraints
N77-11784

Mathematical statistics and probability: Stochastic processes
[AD-A024082] N77-11787

Nonlinear optimization and generalized Lagrange multipliers
[AD-A024413] N77-11793

Design of stochastic linear control systems according to cumulant based performance criteria
[AD-A025078] N77-11795

STOICHIOMETRY
Performance and emission characteristics of swirl-can combustors to near-stoichiometric fuel-air ratio
[NASA-TN-D-8342] N77-11056

STOKES LAW [FLUID MECHANICS]
Local measurement and proportional density of gaseous flow by Raman anti-Stokes coherent scattering
N77-11235

STORAGE STABILITY
Determining the shelflife of solid propellants
N77-11194

STORAGE TANKS
Design and development of a 28 foot tank, elastomeric coated fabric, collapsible, petroleum from a woven tube cloth
[AD-A025595] N77-11182

STRAIN ENERGY METHODS
Strain energy criterion of martensitic transformation
[AD-A023781] N77-11163

STRAIN GAGE BALANCES
Carbon-carbon thermal structural response testing
[AD-A023919] N77-11129

STRAIN GAGES
Significance of measured local strains for the fatigue strength of joints
[LBF-FB-128/76] N77-11446

STRAIN RATE
Rate and time dependent behavior of structural adhesives
N77-11112

Strain rate effects on mechanical properties of fiber composites, part 3
[NASA-CR-135087] N77-11116

The effect of strain rate and temperature on polymers
[AD-A023774] N77-11181

STRATIFIED FLOW
Numerical investigation of the flow of a stratified fluid past a flat plate
N77-10996

STRATOSPHERE
Water vapor in the lower stratosphere measured from aircraft flight
[NASA-TM-X-71220] N77-11618

Preliminary report on electron energy-loss measurements for CClF3, CCl2F2, and CCl3F
[PB-255227/1] N77-11630

Compilation of stratospheric trace gas spectral parameters
[AD-A025490] N77-11632

STREAMS
Technical manual for estimating low-flow frequency characteristics of streams in the Susquehanna River basin
[PB-255455/8] N77-11512

STRESS ANALYSIS
Stress analysis of Navy VLF antenna insulators
[AD-A024054] N77-11312

Nonlinear analyses of the stress field near a crack or hole in a plate
N77-11430

Stiffness and stress analysis of discretely attached corrugated shear webs with quasi-sinusoidal corrugations
N77-11434

Rim-spoke composite flywheels: Stress and vibration analysis
[NASA-TN-D-8339] N77-11442

APES: Second generation two-dimensional fracture mechanics and stress analysis by finite elements
[AD-A025217] N77-11474

STRESS CONCENTRATION
Utilization of human centrifuge for training military pilots in the execution of protective straining maneuvers
N77-11651

STRESS-STRAIN DIAGRAMS
Rate and time dependent behavior of structural adhesives
N77-11112

STRESSES
Investigation of stress levels causing significant damage in composites
[AD-A024537] N77-11127

STROBOSCOPES
Safe use of the P-3 strobe lamp
[AD-A024036] N77-11658

STRUCTURAL ANALYSIS
Follow-up study for the California resilience design method
[PB-255121/6] N77-11454

Structural performance of masonry walls under compression and flexure
[PB-255075/4] N77-11459

Acoustic emission testing for structural applications
[AD-A024064] N77-11460

Revised aircraft load curves and vehicle ice-thickness tables for annual ice sheet operations near McMurdo, Antarctica
[AD-A024051] N77-11461

Additional energy solutions for predicting structural deformations
[AD-A024591] N77-11464

STRUCTURAL DESIGN
The design of filters to have linear passband phase and arbitrary stopband loss
N77-11288

Numerical determination of minimum mass structures with specified natural frequencies
[AD-A023655] N77-11463

STRUCTURAL ENGINEERING
Statistical model of sonic boom structural damage
[AD-A028512/2] N77-11818

STRUCTURAL FAILURE
Analog computation assessment of the risk of structural failure due to crack growth under random loading
[AD-A025266] N77-11042

STRUCTURAL STABILITY
Estimates of blowdown of quasi-static pressures in vented chambers
[AD-A025502] N77-11479

STRUCTURAL STRAIN
Carbon-carbon thermal structural response testing
[AD-A023919] N77-11129

STRUCTURAL VIBRATION
Vibration of a flexible spacecraft with momentum exchange controllers
[NASA-CR-150058] N77-11096

Wind induced vibrations of self supporting conical columns with end mass
N77-11436

STRUCTURAL WEIGHT
Nuclear-powered Hysat spacecraft: Comparative design study
[ERDA-SNS-3063-8] N77-11108

Attic concentrator type solar energy collector
[BNL-50493] N77-11539

STRUCTURES
Estimating external blast loads from suppressive structures
[AD-A025503] N77-11480

SUBGROUPS
Even order subgroups of finite dimensional division rings
N77-11800

SUBROUTINE LIBRARIES [COMPUTERS]
Brief instructions for using MATHLIB [version 6.0]
[SAND-75-0545] N77-11721

SUBSONIC FLOW
Applications of the laser Doppler velocimeter to measure subsonic and supersonic flows
N77-11223

Evaluation of mean and turbulent velocity measurements in subsonic accelerated boundary layers
[NASA-TN-D-8367] N77-11343

SUBSONIC WIND TUNNELS
Description of the model subsonic wind tunnel [MUK] for the large subsonic tunnel [GUK]. Construction, start-up, operation, first results
[DLR-IB-151-75/14] N77-11073

Flow direction measurements in the tandem test sections of the model subsonic wind tunnel [MUK]
[DLR-IB-151-76/1] N77-11074

SUBSTRATES
Production engineering measures to manufacture super fine finish beryllia
[AD-A024470] N77-11315

Highway insulating material evaluation
[PB-254792/5] N77-11466

SUCTION
The effects of wall temperature and suction on laminar boundary-layer stability
[AD-A025337] N77-11355

SULFATES
An evaluation of a fuel-soluble organoboron biocide for control of sulfate-reducing bacteria in shipboard fuel tanks
[AD-A024017] N77-11643

SULFITES
Determination and possible public health impact of transition metal sulfite aerosol species
[PB-255407/9] N77-11590

SULFUR DIOXIDES
The air quality and economic implications of supplementary control systems in Illinois — considering electric power plant fuels
[PB-255699/1] N77-11588

SULFUR OXIDES
Sulfur dioxide interference in the measurement of ambient particulate sulfates, volume 2
[PB-254427/8] N77-11607

SUMS
Calculation of multi-contour thin-walled structures by the method of sections
[NASA-TT-F-17284] N77-11029

SUNSPOTS
Three-dimensional structure of the extended solar magnetic field and the sunspot cycle variation in cosmic ray intensity
[NASA-CR-149174] N77-11956

SUPERCONDUCTORS
Microwave response of nonequilibrium superconductors
N77-11879

SUPERSONIC AIRCRAFT
A computational system for aerodynamic design and analysis of supersonic aircraft. Part 2: User's manual
[NASA-CR-2716] N77-11005

Investigation of slot cooling for high-speed aircraft
[AD-A024316] N77-11061

SUPERSONIC COMBUSTION RAMJET ENGINES
Ignition, combustion, detonation and quenching of reactive mixtures
[AD-A024343] N77-11060

SUPERSONIC FLOW
Applications of the laser Doppler velocimeter to measure subsonic and supersonic flows
N77-11223

Laser velocimetry applied to transonic and supersonic aerodynamics
N77-11224

Supersonic velocity and turbuience measurements using a Fabry-Perot interferometer
N77-11227

Development of photon correlation anemometry for application to supersonic flows
N77-11231

SUPERSONIC INLETS
Performance and boundary-layer evaluation of a sonic inlet
[NASA-TN-D-8340] N77-11004
SUPERSONIC NOZZLES
Some supersonic wind tunnel nozzle boundary layer characteristics
[AD-A024980] N77-11018
SUPERSONIC TRANSPORTS
Preliminary sizing and performance evaluation of supersonic cruise aircraft
[NASA-TM-X-73936] N77-11031
SUPERSONIC WIND TUNNELS
Some supersonic wind tunnel nozzle boundary layer characteristics
[AD-A024980] N77-11018
SUPPLYING
Electric energy supply alternatives for New York. Phase 2: An appraisal of electrical energy alternatives available to the State of New York
[PB-249881/4] N77-11575
SUPPORT INTERFERENCE
Spherical bearing
[NASA-CASE-MFS-23447-1] N77-11403
SURFACE ACOUSTIC WAVE DEVICES
Photolithographic techniques for Surface Acoustic Wave [SAW] devices
[AD-A025492] N77-11822
SURFACE CRACKS
Nonlinear analyses of the stress field near a crack or hole in a plate
N77-11430
SURFACE DIFFUSION
Development of processes for simultaneous diffusion of several dopant junction or doping elements for power devices
[BMFT-FB-T-76-16] N77-11305
SURFACE FINISHING
The national measurement system for surface finish
[PB-255809/6] N77-11217
Development of new active semiconductor surface passivation technologies for high blocking voltage power devices — thyristors
[BMFT-FB-T-76-15] N77-11304
Production engineering measures to manufacture super fine finish beryllia
[AD-A024470] N77-11315
SURFACE NAVIGATION
Feasibility study of performing system calibration in an operate mode
[AD-A024744] N77-11026
SURFACE PROPERTIES
The International Conference on Colloid and Surface Science [IUPAC]
[AD-A024159] N77-11142
Research on adhesive bonding and surface characteristics of metals at Fokker-VFW
[FOK-R-1816] N77-11405
SURFACE REACTIONS
Effects of jets, wakes, and vortices on lifting surfaces
[NASA-TM-X-73974] N77-10998
Polarization induced surface dipole moments
[AD-A024387] N77-11159
Surface cleaning by glow discharge in high volume gas flow
[AD-A024225] N77-11219
SURFACE VEHICLES
The choice of technology in transport system development
N77-11912
SURGES
Time series analysis applied to data from a single ocean wave gauge
[AD-A023821] N77-11769
SURVEYS
User's guide to petroleum industry survey data type
[PB-256635/4] N77-11544
SUSPENDING [HANGING]
Vibrations of suspended cables
N77-11427
SUSQUEHANNA RIVER BASIN [MD-NY-PA]
Technical manual for estimating low-flow frequency characteristics of streams in the Susquehanna River basin
[PB-255455/8] N77-11512
SWEPT WINGS
Calculation of the flow around a swept wing, taking into account the effect of the three-dimensional boundary layer. Part 1: Wing with turbulent boundary layer
[NLR-TR-75076-U] N77-11011
SWINE
Ventricular pathology in swine at high sustained +G sub z
N77-11646
Effect of sustained +G sub z acceleration on cardiac output and fractionation of cardiac output in awake miniature swine
N77-11650
SWITCHING
The spot frequency design of optimum embedding networks for RF switching, modulation, and phase shifting using power limited switches
N77-11284
SWITCHING CIRCUITS
The modeling of message switches in store-and-forward computer communication networks
N77-11252
Adaptive message switching networks
N77-11262
An HVDC breaker with sequential switching
N77-11286
Discrete modeling and analysis of switching regulators
N77-11287
Window comparator
[NASA-CASE-FRC-10090-1] N77-11296
SWITCHING THEORY
A class of network decomposition switches
[AD-A024325] N77-11797
SYMPHONIE SATELLITES
Visbility investigations for the Symphonie A and B satellites
[DLR-IB-552-74/5] N77-11094
SYSTEM 10 COMPUTER
Research on automatic programming
[AD-A024335] N77-11728
SYSTEMS ANALYSIS
Space station systems analysis study. Part 1, volume 3: Appendices. Book 1: Objective data
[NASA-CR-151104] N77-11083
Electron bombardment propulsion system characteristics for large space systems
[NASA-TM-X-73554] N77-11106
Queuing analysis of an IBM 370 computer system
[AD-A025270] N77-11751
SYSTEMS ENGINEERING
Final approach performance monitor
[AD-A028513/0] N77-11024
Design of pollutant-oriented integrated monitoring systems. A test case: Environmental lead
[PB-255103/4] N77-11595
Research on a high level language approach to operating system design
[AD-A023866] N77-11733
SYSTEMS MANAGEMENT
The consequences of transit fare and service policies: A classified bibliography
[PB-253101/0] N77-11931

T

T-2 AIRCRAFT
Design and fabrication of an 8000 PSI control-by-wire actuator for flight testing in a T-2 C airplane
[AD-A024487] N77-11065
T-39 AIRCRAFT
Preliminary design-lift/cruise fan research and technology airplane flight control system
[NASA-CR-137971] N77-11064
TABLES [DATA]
Small axial compressor technology, volume 2 — tables
[NASA-CR-134827-VOL-2] N77-11049
Tables for determining isotropic and anisotropic shear strengths from consolidated undrained triaxial compression tests
[AD-A024025] N77-11625
TANKS [CONTAINERS]
Dynamic behavior of fluid-tank systems
N77-11325
TANTALUM
The oxidation of T-111 alloy at high termperatures and low pressures
N77-11145
Thin film circuits for future applications. Part 1: Basic investigations and sputtering technique
[BMFT-FB-T-76-20] N77-11306
TAPE RECORDERS
Computer program for converting visual display from DEC, GT-44 to Stromberg datagraphi X4020
[AD-A025081] N77-11736
TARGET ACQUISITION
Computerized analysis of eye movements during static display visual search
[AD-A024100] N77-11680
Target detection in rapidly-changing visual sequences
[AD-A023784] N77-11685
TARGET RECOGNITION
Reduction of target detectability by laser protective materials
[AD-A024383] N77-11682
TASK COMPLEXITY
Guidelines for research planning and design in task analysis
[AD-A024132] N77-11898
TEARING
Study of variables affecting lamellar tearing susceptibility of steels
N77-11152
TECHNOLOGICAL FORECASTING
A review of case studies of technological innovations in state and local services
[PB-252914/7] N77-11926
An analysis of the technology role in US power during the mid-range period
[AD-A024042] N77-11927
TECHNOLOGY ASSESSMENT
Small axial compressor technology, volume 1
[NASA-CR-134827-VOL-1] N77-11048
Bosch technical instruction. Gasoline injection D and L-jetronic
[NASA-TT-F-17111] N77-11399
Technology for using sulfate waste in highway construction
[PB-254815/4] N77-11468
Industrial thermal insulation: An assessment
[ORNL-TM-5283] N77-11534
Mathematics for energy
[PB-252463/5] N77-11543
The use of an interactive energy model for technology assessment with special reference to underground coal gasification
[PB-255543/1] N77-11545
Proceedings of the Workshop on Modeling the Interrelationships between the Energy Sector and the General Economy
[PB-255696/7] N77-11561
Total suspended particulates: Review and analysis
[PB-255858/3] N77-11574
Cost-benefit analysis of space technology
[NASA-TM-X-3453] N77-11908
The choice of technology in transport system development
N77-11912
TECHNOLOGY TRANSFER
Report to AID on a Phillipines survey on standardization and measurement services
[PB-255803/9] N77-11216
Man, design, machine: An inquiry into principles of normative planning for computer-based technical systems illustrated by a case design of an entry, storage and retrieval system for scientific communication and technology tranfer
N77-11743
Application of principles of organizational structure to high technology activities
[AD-A024012] N77-11895
Benefit assessment of NASA space technology goals
[NASA-CR-149192] N77-11914
Biomedical technology transfer: Applications of NASA science and technology
N77-11915
Investigation of the medical applications of the unique biocarbons developed by NASA
[NASA-CR-150061] N77-11916
TECHNOLOGY UTILIZATION
Military rocket aircraft: Inherent constraints and their uses
N77-11186
Applications of satellite technology for regional organizations [Project ASTRO]
[NASA-CR-149184] N77-11267
Benefit assessment of NASA space technology goals
[NASA-CR-149192] N77-11914
Urban design and usage factors of paratransit vehicles and facilities
[PB-255541/5] N77-11929
TECTONICS
Morphostructural methods of studying the tectronics of enclosed platforms, petroleum-gas-bearing regions
[NASA-TT-F-16734] N77-11615
TEFLON [TRADEMARK]
Flexible, FEP-Teflon covered solar cell module development
[NASA-CR-135109] N77-11531
TELECOMMUNICATION
Centralized teleprocessing network design
N77-11260
Channel assignment in cellular mobile telecommunication systems
N77-11263
A preliminary review of current practices and trends in rural telecommunications development and recommendations for future development
[PB-254366/8] N77-11274
TEMPERATURE DISTRIBUTION
Local temperatures in semigray nondiffuse cones and V-grooves
N77-11341
TEMPERATURE EFFECTS
The effect of strain rate and temperature on polymers
[AD-A023774] N77-11181
Electrical transport properties of itinerant and localized electron magnetic systems
N77-11878
TEMPERATURE MEASUREMENT
An experimental and analytical study of the sputtering phenomena
N77-11336
TENSORS
A classical theory of the dielectric susceptibility of anharmonic crystals
N77-11874

TERMINAL GUIDANCE
Test and evaluation of the beacon processing subsystem of the Automated Radar Terminal Systems [ARTS III] all-digital tracking level system
[AD-A028514/8] N77-11025
TERRESTRIAL RADIATION
Earth magnetism, the aurora and ultralow-frequency radiation
[NASA-TT-F-16737] N77-11616
TEST FACILITIES
The Langley thermal protection system test facility: A description including design operating boundaries
[NASA-TM-X-73973] N77-11067
TESTING TIME
Mechanism of material fatigue during the crack initiation stage
[ICAF-DOC-895] N77-11641
TETHERLINES
Tetherline system for orbiting satellites
[NASA-CASE-MFS-23564-1] N77-11079
TEXTURES
Experiments in texture perception
[AD-A024975] N77-11855
THEMATIC MAPPING
Resource and environmental surveys from space with the thematic mapper in the 1980's
[NASA-CR-149191] N77-11508
THEOREMS
Augmenting Lehman alternatives
[AD-A023789] N77-11789
Almost completely decomposable groups
N77-11801
Higher K-theory of regular rings
N77-11804
THERMAL BOUNDARY LAYER
Thermal boundary layer flow of absorbing and emitting high temperature air
N77-11333
THERMAL BUCKLING
Thermal activity of base course material related to pavement cracking
[PB-254754/5] N77-11476
THERMAL CONDUCTIVITY
Separations of multicomponent mixtures via thermal parametric pumping
N77-11328
Thermal conductivity of heavily doped p-type indium antimonide
N77-11876
THERMAL CONTROL COATINGS
Passivation of pigment particles for thermal control coatings
[NASA-CR-150046] N77-11174
THERMAL CYCLING TESTS
Lamination residual stresses in hybrid composites, part 1
[NASA-CR-135085] N77-11114
THERMAL DEGRADATION
A study of the factors affecting deposition characteristics of synthetic lubricants for gas turbine engines
[AD-A024472] N77-11410
THERMAL EMISSION
The Apollo 17 infrared scanning radiometer
N77-11950
THERMAL ENERGY
Experimental and analytical study of thermal acoustic oscillations — in the transfer and storage of cryogens
[NASA-CR-150051] N77-11212
Selected aspects of waste heat management: A state-of-the-art study
[PB-255697/5] N77-11563
THERMAL INSULATION
Highway insulating material evaluation
[PB-254792/5] N77-11466
Industrial thermal insulation: An assessment
[ORNL-TM-5283] N77-11534
Frost insulating materials in roads
[VTI-40] N77-11917
THERMAL POLLUTION
Penetration and mixing of heated discharges into waterways
[PB-253957/5] N77-11580
THERMAL PROTECTION
The Langley thermal protection system test facility: A description including design operating boundaries
[NASA-TM-X-73973] N77-11067
Intumescent coating containing 4,4'-dinitrosulfanilide
[NASA-CASE-ARC-11042-1] N77-11119
Improved thermal protection and rewarm procedures for cold water divers
[AD-A024213] N77-11660
THERMAL RESISTANCE
Investigation into the influence of natural weathering on the fire resistant property of FFP 5.552 [F-coat]
[FOK-R-1932] N77-11176
THERMIONIC CATHODES
Technological studies of high mission current density cathodes
[BMFT-FB-T-76-10] N77-11301
THERMOCHEMISTRY
Thermochemical water splitting: The reverse Deacon reaction and alternatives
[IS-M-63] N77-11541
THERMOCHROMATIC MATERIALS
Sources of organic color in natural waters
N77-11484
THERMOCOUPLES
High temperature thermocouple system for advanced aircraft turbine engines
[AD-A025500] N77-11062
THERMODYNAMIC PROPERTIES
Carbon-carbon thermal structural response testing
[AD-A023919] N77-11129
Optical measurements of thermodynamic properties in flow fields. A review
N77-11233
Thermodynamic study of metal ion-macrocyclic ligand interaction
N77-11890
Occurence of gas hydrates in the nucleii of comets
[NASA-TT-F-16740] N77-11937
THERMODYNAMICS
On the kinetics and thermodynamics of metallic solid solutions
N77-11150
A device for rapid determination of thermophysical properties of phase-change wind-tunnel models
[NASA-TM-X-3421] N77-11346
The thermodynamics and kinetics of interstitial solid solutions
N77-11883
THICKNESS
Fracture toughness tests on compressive preloaded specimens with a thickness of 5 mm — in crack presence
[FOK-R-1839] N77-11448
THIN FILMS
Thin film circuits for future applications. Part 1: Basic investigations and sputtering technique
[BMFT-FB-T-76-20] N77-11306
Thin film circuits for future applications. Part 2: Evaporation technique
[BMFT-FB-T-76-21] N77-11307
The epitaxial growth of thin films and the interfacial dislocations studied by RHEED and transmission electron microscopy
N77-11868
Static magnetic properties of DC biased RF sputtered GdFe amorphous films
N77-11871
Microwave response of nonequilibrium superconductors
N77-11879
THIN WALLED SHELLS
Calculation of multi-contour thin-walled structures by the method of sections
[NASA-TT-F-17284] N77-11029
THIXOTROPY
Thixotropic properties of polymer melts
N77-11173
THORIUM COMPOUNDS
Pulse NMR in solids: Chemical shift, lead fluoride and thorium hydride
N77-11873
THREE DIMENSIONAL BOUNDARY LAYER
An ALGOL program for the calculation of incompressible three dimensional turbulent boundary layers
[NLR-TR-74159-U] N77-11010
Calculation of the flow around a swept wing, taking into account the effect of the three-dimensional boundary layer. Part 1: Wing with turbulent boundary layer
[NLR-TR-75076-U] N77-11011
THREE DIMENSIONAL FLOW
Controlled and uncontrolled flow separation in three dimensions
[LR-591] N77-10999
Numerical solution of supersonic three-dimensional free-mixing flows using the parabolic-elliptic Navier-Stokes equations
[NASA-TN-D-8195] N77-11342
Analysis of the data from the three-dimensional gradient study — for atmospheric pollutant layers diffusion
[PB-253936/9] N77-11578
THREE DIMENSIONAL MOTION
Three-dimensional finite element analysis of a large circular disc with circular penetrations
[WAPD-TM-1206] N77-11444
THRUST AUGMENTATION
Analysis and design of ejector diffuser for optimum thrust
[AD-A025491] N77-11356
THRUST VECTOR CONTROL
Ground test of the D shaped vented thrust vectoring nozzle
[NASA-CR-137959] N77-11107
THUNDERSTORMS
Some effects of the shearing and veering environmental flow on the internal dynamics and structure of a severe thunderstorm during its mature stage
N77-11633
Initiation of non-tropical thunderstorms by solar activity
[NASA-TM-X-71222] N77-11635
THYRISTORS
Development of new active semiconductor surface passivation technologies for high blocking voltage power devices — thyristors
[BMFT-FB-T-76-15] N77-11304
TIME DEPENDENCE
Rate and time dependent behavior of structural adhesives
N77-11112
Experimental and numerical studies of rate-dependent materials
N77-11429
TIME MEASUREMENT
Time variations of HF induced plasma waves
N77-11611
TIME OPTIMAL CONTROL
Time domain filtering, estimation and prediction techniques in power systems
N77-11285
TIME SERIES ANALYSIS
Time series analysis applied to data from a single ocean wave gauge
[AD-A023821] N77-11769
A canonical analysis of multiple time series
[AD-A023861] N77-11773
TIME SHARING
Electrical characteristics for rectangular conductors — using four computer programs
[SAND-75-0626] N77-11297
MULTI8, the PDP8 real-time operating system for multitasking foreground- and timesharing background operation. Part 1: Introduction to MULTI8
[MBL-1975-7] N77-11724
TIRES
Development of mathematical model for pneumatic tire-soil interaction in layered soils
[AD-A024162] N77-11416
Factors contributing to low-friction between wheels and road surface
[VTI-52] N77-11919
TISSUES [BIOLOGY]
Potential biomedical applications of ion beam technology
[NASA-TM-X-73512] N77-11655
TITANIUM
Evaluation of potassium titanate as a component of alkaline fuel cell matrices
[NASA-TN-D-8341] N77-11175
Weld-bonded titanium structures
[NASA-CASE-LAR-11549-1] N77-11397
TITANIUM ALLOYS
Electrolytic hydrogen in beta titanium
N77-11146
Studies of the kinetics of environmental hydrogen embrittlement in titanium alloys
N77-11151
Basic mechaniams providing oxidation resistance in structural metals at high temperatures. Volume 2: The defect structure of nonstoiometric rutile [Ti O2] and nonstoichiometric rutile containing 1 to 10 mole percent Cb205
[AD-A024540] N77-11161
Strain energy criterion of martensitic transformation
[AD-A023781] N77-11163
Computer-aided design and manufacturing for extrusion of aluminum, titanium, and steel structural parts [phase 1]
[AD-A023946] N77-11171
Mechanisms of adhesion failure between polymers and metallic substrates. Part 2: Aluminum 2024-T3 and titanium 6Al4V with HT424 adhesive
[AD-A025256] N77-11183
TOKAMAK FUSION REACTORS
Environmental and safety aspects of alternative nuclear power technologies. Fusion power systems
[PB-255502/7] N77-11564
TOPOGRAPHY
AS-11B-X automated stereomapper
[AD-A025428] N77-11524
TOPOLOGY
On discrete-time polynomial systems
[AD-A024481] N77-11774
Characterization theorem for topological semilattices on the two-cell
N77-11803
TORSION
Torsion and the geometry of spin
N77-11808
TOXICITY AND SAFETY HAZARD
Asphalt hot-mix emission study
[PB-250504/8] N77-11542
TRACE ELEMENTS
Sensors for continuous monitoring of toxic ions, nutrients, and dissolved gases in water
[PB-254834/5] N77-11387
Compilation of stratospheric trace gas spectral parameters
[AD-A025490] N77-11632
TRACKING RADAR
Simulation of automatic detection and track-while-scan systems for unstabilized shipboard radars
N77-11257
TRADEOFFS
Trade-off analyses for multi-objective transportation plans
N77-11911
TRAJECTORY OPTIMIZATION
Optimal multiple-arc trajectories for an all-aspect air-to-air missile
N77-11082

Development of a small solid propellant rocket motor for flexible range requirements
N77-11188
TRANSDUCERS
Resonant pressure instrumentation
N77-11358
TRANSIENT LOADS
Wave propagation in fiber composite laminates, part 2
[NASA-CR-135086] N77-11115
TRANSIENT RESPONSE
Transient behavior of an adaptive array
N77-11250
TRANSISTORS
Susceptibility of UHF RF transistors to high power UHF signals, part 2
[AD-A024394] N77-11316
TRANSITION METALS
Diffusion in transition metals and alloys and selective adsorption and hydrogen embrittlement
N77-11144
TRANSMISSION
Radiation and coupling properties of straight and curved optical waveguides
N77-11851
TRANSMISSION LINES
Development of an optical fiber video data link
[AD-A025220] N77-11027
TRANSMISSION LOSS
Location variability of transmission loss: Land mobile and broadcast systems
[PB-254472/4] N77-11272
TRANSMITTER RECEIVERS
Test program for transmitter experiment package and heat pipe system for the communications technology satellite
[NASA-TM-X-3455] N77-11268
Interference problems associated with proposed expansion of the 27 MHz citizens radio service band. Part I: Summary
[PB-254488/0] N77-11271
TRANSONIC COMPRESSORS
Compressor blade setting angle accuracy study. Volume 2: Data compilation
[NASA-CR-135068-VOL-2] N77-11047
Small axial compressor technology, volume 1
[NASA-CR-134827-VOL-1] N77-11048
Small axial compressor technology, volume 2 --- tables
[NASA-CR-134827-VOL-2] N77-11049
TRANSONIC FLOW
Viscous interaction with separation in transonic flow
[NASA-TT-F-17187] N77-10997
Laser velocimetry applied to transonic and supersonic aerodynamics
N77-11224
TRANSONIC WIND TUNNELS
On the flow quality necessary for the Large European High-Reynolds-Number Transonic Windtunnel LEHRT
[AGARD-R-644] N77-11070
An investigation of the aerodynamic characteristics of a 0.00548 scale model [model no. 486] of the space shuttle 146-inch diameter solid rocket booster at angels of attack from 113 deg to 180 deg in the AEDC PWT 4-foot transonic wind tunnel [SA16F]
[NASA-CR-147648] N77-11090
Application of the dual-scatter laser velocimeter in transonic flow research
N77-11225
TRANSPORT AIRCRAFT
Application of design data derived from fatigue tests with service-like load sequences for life prediction --- wing structures of transport aircraft
[LBF-FB-109/76] N77-11445
TRANSPORT PROPERTIES
Effect of polymer state on the mechanical and transport behavior of polymer impregnated mortars
N77-11425
An invariant imbedding, orders-of-scattering approach to particle transport in a slab
[AD-A024155] N77-11832
Transport processes within a plasma driven by a high-frequency electric field
N77-11859
Investigation of electronic transport, recombination and optical properties in In As sub 1-x P sub x alloy systems
[AD-A025294] N77-11889
TRANSPORT THEORY
Chemically reacting flows in porous media
N77-11327
TRANSPORTATION
Conference report: Energy Conservation in Transportation and Construction
[PB-255857/5] N77-11562
TRANSPORTATION ENERGY
Optimizing the use of materials and energy in transportation construction
[PB-253713/2] N77-11475
Assessing the relationship between urban form and travel requirements: A literature review and conceptual framework
[PB-254988/9] N77-11923
Future scenarios for urban transportation
[PB-255349/3] N77-11930
TRANSPORTER
The choice of technology in transport system development
N77-11912
TRAPPED PARTICLES
A photocurrent spectroscopic method for determination of trapping state distributions in silicon dioxide thin films
N77-11875
TRAVELING WAVE TUBES
Description and expected performance of flight-model, 12-gigahertz, output stage tube for the communications technology satellite
[NASA-TM-X-3441] N77-11295
Intermodulation study
[AD-A023906] N77-11308
TRAVELING WAVES
Radiation from a current filament driven by a traveling wave
[NASA-TN-D-8302] N77-11294
TREES [MATHEMATICS]
Efficient solutions in multiobjective tree network location problems
[AD-A025289] N77-11777
TRIAXIAL STRESSES
Tables for determining isotropic and anisotropic shear strengths from consolidated undrained triaxial compression tests
[AD-A024025] N77-11625
TROPICAL REGIONS
Application of remote sensing techniques for the study and evaluation of natural resources in Peru
[E77-10024] N77-11487
TUBE CATHODES
High reliability cathode heaters for ion thrusters
[NASA-TM-X-73538] N77-11105
TUNGSTEN
The oxidation of T-111 alloy at high termperatures and low pressures
N77-11145
TUNNEL DIODES
Properties of Cr-SiO2-n Si tunnel diodes
N77-11291
TURBINE BLADES
Investigation of slot cooling for high-speed aircraft
[AD-A024316] N77-11061
Directionally solidified in situ metal matrix composites, part 1 --- superalloys for manufacture of turbine blades
[AD-A024217] N77-11162
Development of directionally solidified eutectic nickel and cobalt alloys --- for turbine blades
[AD-A024420] N77-11165
Cyclic structural analysis of air-cooled gas turbine blades and vanes
[NASA-TM-X-73494] N77-11439
Performance and optimum design analysis/computation for propeller type wind turbines
N77-11527
TURBOCOMPRESSORS
The rotating stator concept. Experimental performance characteristics compared with the conventional compressor
[AD-A024465] N77-11411
Transients in turbocompressors --- effect of unsteady flow on compressor performance
[AD-A024275] N77-11412
TURBOFAN ENGINES
Macroscopic study of time unsteady noise of an aircraft engine during static tests
[NASA-TM-X-73556] N77-11052
Core noise source diagnostics on a turbofan engine using correlation and coherence techniques
[NASA-TM-X-73535] N77-11053
Study of small turbofan engines applicable to single-engine light airplanes
[NASA-CR-137944] N77-11054
Method of discrete modeling and its application to estimation of TF30 engine variables
[NASA-TM-X-3443] N77-11057
The rotating stator concept. Experimental performance characteristics compared with the conventional compressor
[AD-A024465] N77-11411
TURBULENT BOUNDARY LAYER
Performance and boundary-layer evaluation of a sonic inlet
[NASA-TN-D-8340] N77-11004
An ALGOL program for the calculation of incompressible three dimensional turbulent boundary layers
[NLR-TR-74159-U] N77-11010
Calculation of the flow around a swept wing, taking into account the effect of the three-dimensional boundary layer. Part I: Wing with turbulent boundary layer
[NLR-TR-75076-U] N77-11011
Some supersonic wind tunnel nozzle boundary layer characteristics
[AD-A024980] N77-11018
The application of a laser anemometer to the investigation of shock-wave boundary-layer interactions
N77-11226
An experimental study of compressible turbulent boundary layer separation at high Reynolds numbers
N77-11321
Evaluation of mean and turbulent velocity measurements in subsonic accelerated boundary layers
[NASA-TN-D-8367] N77-11343
Comparison of data from two shock wave turbulent boundary layer interaction experiments
[AD-A024520] N77-11352
An investigation of optically relevant turbulence parameters in the marine boundary layer
[AD-A025421] N77-11631
TURBULENT FLOW
On the flow quality necessary for the Large European High-Reynolds-Number Transonic Windtunnel LEHRT
[AGARD-R-644] N77-11070
Recent applications of ISL of the laser velocimeter measurements in turbulent flows
N77-11228
Single scattering particle laser Doppler measurements of turbulence
N77-11230
The electron beam fluorescence technique applied to hypersonic turbulent flows
N77-11236
Simultaneous laser measurements of instantaneous velocity and concentration in turbulent mixing flows
N77-11247
Development of the electron beam fluorescence technique for measurements in a hypersonic turbulent flow
N77-11326
Experimental investigation of coaxial turbulent jets
N77-11337
New applications of laser anemometry to turbulent flow
[ISL-CO-212/75] N77-11349
Structure of two-dimensional turbulent wall-jets in the presence of adverse pressure gradients
[NASA-CR-149126] N77-11354
Comparison of instantaneous velocity measurements by hot-wire anemometry and laser anemometry --- in cold free jet flow
[ISL-R-117/75] N77-11371
TURBULENT WAKES
High speed computer studies of vortex motions in relation to aircraft wake turbulence
[AD-A024290] N77-11013
TURING MACHINES
The complexity of parallel algorithms
N77-11707
Adaptive computer-assisted tutorials: A cybernetic approach optimization with finite-state machines
[AD-A024252] N77-11758
TWO DIMENSIONAL BOUNDARY LAYER
Hydrodynamic aspects of the critical heat flux in subcooled convection boiling
N77-11329
TWO DIMENSIONAL FLOW
Numerical investigation of the flow of a stratified fluid past a flat plate
N77-10996
A FORTRAN program for the computation of two-dimensional or axisymmetric nozzles --- applied to supersonic free jets
[ISL-R-110/75] N77-11012
Comparison of data from two shock wave turbulent boundary layer interaction experiments
[AD-A024520] N77-11352
TWO DIMENSIONAL JETS
Structure of two-dimensional turbulent wall-jets in the presence of adverse pressure gradients
[NASA-CR-149126] N77-11354
TWO PHASE FLOW
The time-of-flight laser anemometer
N77-11243

U

U.S.S.R.
Toward new heights --- air transportation in the Soviet Union
[NASA-TT-F-17248] N77-11019
Equipment for the cosmonaut
[NASA-TT-F-17275] N77-11670
UH-1 HELICOPTER
Helicopter reliability growth evaluation
[AD-A025265] N77-11041
ULTRAHIGH FREQUENCIES
Susceptibility of UHF RF transistors to high power UHF signals, part 2
[AD-A024394] N77-11316
ULTRASONIC TESTS
Ultrasonic inspection of seat-back ejection rocket motors
[AD-A024379] N77-11385
Ultrasonic examination of thin iridium hemispheres for the multihundred watt heat source
[MLM-2291] N77-11419
ULTRASONICS
Characterization of fatigue cracks with ultrasonics
N77-11432

ULTRAVIOLET SPECTROSCOPY
Improved microwave-discharge source for UV photoemission
[PB-255204/0] N77-11382
UNITED STATES OF AMERICA
The ten-ecosystem study investigation plan
[NASA-CR-151099] N77-11505
LANDSAT: US Standard catalog — LANDSAT imagery for August 1976
[NASA-TM-X-74216] N77-11523
UNIVAC COMPUTERS
TEKPACK: A utility package for the Tektronix 4012 graphics terminal and the Univac 1830A digital computer
[AD-A025505] N77-11702
Utility programs for the UNIVAC 9300 system at the MCL computer facility
[PB-255891/4] N77-11739
UNSTEADY FLOW
The measurement of spatial vorticity distributions using hot-wire anemometry techniques
[AD-A024161] N77-11014
Transients in turbocompressors — effect of unsteady flow on compressor performance
[AD-A024275] N77-11412
URBAN DEVELOPMENT
Transportation planning for small urban areas
[PB-256119/9] N77-11932
URBAN PLANNING
Guidelines for air quality maintenance planning and analysis. Volume 14. Designated air quality maintenance areas
[PB-254961/6] N77-11606
The census and transportation planning: Survey of evaluations and recommendations as to the usefulness of the 1970 census data in urban transportation planning
[PB-254802/2] N77-11924
Planning and programming for transportation
[PB-255637/1] N77-11925
Transportation planning for small urban areas
[PB-256119/9] N77-11932
URBAN TRANSPORTATION
The operation of hovercraft in New York City metropolitan area. Volume 2: Economic feasibility
[PB-251235/8] N77-11021
A study of the remote neighborhood office center concept
[NASA-CR-149190] N77-11892
Trade-off analyses for multi-objective transportation plans
N77-11911
Advanced dial-a-ride algorithms research project
[PB-254752/9] N77-11922
Assessing the relationship between urban form and travel requirements: A literature review and conceptual framework
[PB-254988/9] N77-11923
The census and transportation planning: Survey of evaluations and recommendations as to the usefulness of the 1970 census data in urban transportation planning
[PB-254802/2] N77-11924
Planning and programming for transportation
[PB-255637/1] N77-11925
Urban design and usage factors of paratransit vehicles and facilities
[PB-255541/5] N77-11929
Future scenarios for urban transportation
[PB-255349/3] N77-11930
The consequences of transit fare and service policies: A classified bibliography
[PB-253101/0] N77-11931
Transportation planning for small urban areas
[PB-256119/9] N77-11932
UREAS
Polymer pavement concrete for Arizona study 2
[PB-255692/6] N77-11470
URINE
Electrolytic pretreatment unit gaseous effluent conditioning
[NASA-CR-151101] N77-11671
USER MANUALS (COMPUTER PROGRAMS)
A computational system for aerodynamic design and analysis of supersonic aircraft. Part 2: User's manual
[NASA-CR-2716] N77-11005
The multivariable identification package for a PDP-11 computer: User guide
[OUEL-1142/76] N77-11725
Graph information retrieval language: Programming manual for FORTRAN complement, revision 1
[AD-A025292] N77-11735
An operating manual for computer storage, access and presentation of plant trial data
[PB-256058/9] N77-11737
USER REQUIREMENTS
A technological review: The future of microimagery in the library
[PB-255725/4] N77-11906
UTAH
Improvement of Utah's flexible pavement performance system
[PB-254819/6] N77-11462

V

V GROOVES
Local temperatures in semigray nondiffuse cones and V-grooves
N77-11341
V/STOL AIRCRAFT
V/STOL aircraft noise prediction [jet propulsors] — computer program
[AD-A028765/6] N77-11045
Preliminary design-lift/cruise fan research and technology airplane flight control system
[NASA-CR-137971] N77-11064
VACUUM DEPOSITION
Thin film circuits for future applications. Part 2: Evaporation technique
[BMFT-FB-T-76-21] N77-11307
VACUUM TESTS
Lubrication of bearings in vacuum. Examination of life-tested bearings from MSDS Ltd — lead and grease lubricants
[T[F]S/128] N77-11407
VAN DER WAAL FORCES
Polarization induced surface dipole moments
[AD-A024387] N77-11159
VANES
Cyclic structural analysis of air-cooled gas turbine blades and vanes
[NASA-TM-X-73494] N77-11439
VAPOR DEPOSITION
Chemically reacting flows in porous media
N77-11327
VAPOR PHASES
Compilation of stratospheric trace gas spectral parameters
[AD-A025490] N77-11632
VAPORIZERS
Preliminary aerosol generator design studies
[NASA-CR-150050] N77-11081
VAPORS
Electrochemical analysis of sulfidic and amine odorants
[PB-255092/9] N77-11591
VECTORCARDIOGRAPHY
Changes in clinical cardiologic measurements associated with high +G sub z stress
N77-11645
VEGETATION GROWTH
Resource and environmental surveys from space with the thematic mapper in the 1980's
[NASA-CR-149191] N77-11508
Inferential techniques for soil depth determinations. Part 1: Coleogyne ramosissima Torr. [Black-brush]
[AD-A024355] N77-11627
VEHICLE WHEELS
Factors contributing to low friction between wheels and road surface
[VTI-52] N77-11919
VELOCITY MEASUREMENT
Shape analysis of pulsed second sound in superfluid helium
N77-11210
Laser velocimetry applied to transonic and supersonic aerodynamics
N77-11224
Supersonic velocity and turbulence measurements using a Fabry-Perot interferometer
N77-11227
Recent applications of ISL of the laser velocimeter measurements in turbulent flows
N77-11228
Single scattering particle laser Doppler measurements of turbulence
N77-11230
Flow field in the wake of a blunt body by laser Doppler anemometry
N77-11245
Investigation of a V-gutter stabilized flame by laser anemometry and schlieren photography
N77-11246
Simultaneous laser measurements of instantaneous velocity and concentration in turbulent mixing flows
N77-11247
A three-component laser-Doppler-velocimeter
N77-11248
Evaluation of mean and turbulent velocity measurements in subsonic accelerated boundary layers
[NASA-TN-D-8367] N77-11343
New applications of laser anemometry to turbulent flow
[ISL-CO-212/75] N77-11349
Laser anemometry and displacement of the measurement point in industrial wind tunnels — in France
[ISL-R-116/75] N77-11370
Comparison of instantaneous velocity measurements by hot-wire anemometry and laser anemometry — in cold free jet flow
[ISL-R-117/75] N77-11371
Further development of a method for measuring velocity and length by laser technology
[BMFT-FB-T-76-17] N77-11377
An inverse method for determining small variations in propagation speed
[AD-A025296] N77-11467
VENTS
Ground test of the D shaped vented thrust vectoring nozzle
[NASA-CR-137959] N77-11107
VERNIER ENGINES
Space shuttle contamination due to backflow from control motor exhaust
[NASA-CR-150054] N77-11092
VERTICAL TAKEOFF AIRCRAFT
Display/control requirements for VTOL aircraft
[NASA-CR-145026] N77-11030
Analysis and design of ejector diffuser for optimum thrust
[AD-A025491] N77-11356
VIBRATION
Vibrations of suspended cables
N77-11427
Lateral vibrations of an extending rod
[UTIAS-TN-202] N77-11438
Tabulation of hybrid theory calculated e-N2 vibrational and rotational cross sections
[NASA-TN-D-8347] N77-11830
VIBRATION MEASUREMENT
Vibration of a flexible spacecraft with momentum exchange controllers
N77-11095
VIBRATION MODE
Calculation of vibration modes and resonance frequencies of the Northrop NF-5
[NLR-TR-75050-U] N77-11450
VIBRATIONAL STRESS
Rim-spoke composite flywheels: Stress and vibration analysis
[NASA-TN-D-8339] N77-11442
Cardiovascular, renal and respiratory effects of high intensity, intermediate duration, low frequency vibration
[AD-A025098] N77-11664
VIEWING
New storage tubes
[BMFT-FB-T-76-02] N77-11298
VIKING LANDER SPACECRAFT
A spectral reflectance estimation technique using multispectral data from the Viking lander camera
[NASA-TN-D-8292] N77-11099
VIRUSES
Virion aggregation and disinfection of water viruses by bromine
[PB-253087/1] N77-11642
VISCOELASTICITY
Simple thickness modes and shear correction coefficients for viscoelastic Timoshenko beams
[AD-A023771] N77-11125
On buckling of viscoelastic plates
N77-11443
VISCOSITY
An analysis of data taken from the impact viscometer at Imperial College
[AD-A023143] N77-11178
VISCOUS FLOW
Vortex/jet/wing viscous interaction theory and analysis
[AD-A025290] N77-11017
Numerical solution of supersonic three-dimensional free-mixing flows using the parabolic-elliptic Navier-Stokes equations
[NASA-TN-D-8195] N77-11342
Viscous flow at the boundary of a porous material
[AD-A022715] N77-11351
VISIBILITY
Visibility investigations for the Symphonie A and B satellites
[DLR-IB-552-74/5] N77-11094
VISION
An application of Wiener analysis to human visual psychophysical response
N77-11669
VISUAL FIELDS
Target detection in rapidly-changing visual sequences
[AD-A023784] N77-11685
VISUAL PERCEPTION
Reduction of target detectability by laser protective materials
[AD-A024383] N77-11682
Dynamic contrast requirements — relationship between human visual system and displayed imagery
[AD-A023973] N77-11683
Experiments in texture perception
[AD-A024975] N77-11855
VISUAL STIMULI
The effect of pre-adapting spectral stimuli on visual response
[AD-A024312] N77-11659
VOICE DATA PROCESSING
Random bit generator
[AD-A024019] N77-11748
VOID RATIO
Study of variables affecting lamellar tearing susceptibility of steels
N77-11152
VOLCANOES
Investigation of environmental change pattern in Japan
[E77-10025] N77-11488

VORTEX SHEETS
High speed computer studies of vortex motions in relation to aircraft wake turbulence
[AD-A024290] N77-11013
Vortex/jet/wing viscous interaction theory and analysis
[AD-A025290] N77-11017
VORTICES
Effects of jets, wakes, and vortices on lifting surfaces
[NASA-TM-X-73974] N77-10998
Development of predictive wake vortex transport model for terminal area wake vortex avoidance
[AD-A029049/4] N77-11002
The inviscid pressure field on the tip of a semi-infinite wing and its application to the formation of a tip vortex
[NASA-CR-2748] N77-11345
VORTICITY
The measurement of spatial vorticity distributions using hot-wire anemometry techniques
[AD-A024161] N77-11014

W

WAFERS
Manufacturing methods and technology engineering high efficiency high power gallium arsenide read-type IMPATT diodes
[AD-A023913] N77-11309
WAKES
Infrared signature modifications, volume 1
[AD-A024653] N77-11854
WALL JETS
Structure of two-dimensional turbulent wall-jets in the presence of adverse pressure gradients
[NASA-CR-149126] N77-11354
WALL TEMPERATURE
The effects of wall temperature and suction on laminar boundary-layer stability
[AD-A025337] N77-11355
WASTE DISPOSAL
Steel from urban waste
[PB-255441/8] N77-11167
Technology for using sulfate waste in highway construction
[PB-254815/4] N77-11468
Optimal productivity for solid waste collection: A systems approach
N77-11913
WASTE UTILIZATION
Steel from urban waste
[PB-255441/8] N77-11167
Optimal management of the subsurface environment: Parameter identification
[PB-255648/8] N77-11921
WASTE WATER
Selected aspects of waste heat management: A state-of-the-art study
[PB-255697/5] N77-11563
Characterization and evaluation of wastewater sources United States Steel Corporation, Homestead wheel and axle plant, McKees Rocks, Pennsylvania, August 21-28, 1975
[PB-255593/6] N77-11586
WATER
Aqueous artefacts: The riddle of bound water
[AD-A024643] N77-11663
WATER COOLED REACTORS
Axial xenon redistribution and power shaping in large pressurized water reactors
N77-11845
WATER FLOW
Penetration and mixing of heated discharges into waterways
[PB-253957/5] N77-11580
WATER POLLUTION
Spectral reflectance signatures of coastal pollutants — Delaware
[E77-10011] N77-11486
Red River chloride remote sensing study
[NASA-CR-149189] N77-11503
The status and quality of radiation measurements of water
[PB-255107/5] N77-11584
Characterization and evaluation of wastewater sources United States Steel Corporation, Homestead wheel and axle plant, McKees Rocks, Pennsylvania, August 21-28, 1975
[PB-255593/6] N77-11586
Characterization and evaluation of wastewater sources United States Steel Corporation, Duquesne plant, Pittsburgh, Pennsylvania, February 26 - March 6, 1976
[PB-255594/4] N77-11587
Designing a river basin sampling system
[PB-255022/6] N77-11593
Sediment studies in Back River Estuary, Baltimore, Maryland
[PB-255584/5] N77-11594
Design of pollutant-oriented integrated monitoring systems. A test case: Environmental lead
[PB-255103/4] N77-11595
An assessment of estuarine and nearshore marine environments
[PB-254853/5] N77-11598
Technical guidelines for public water systems
[PB-255217/2] N77-11928
WATER QUALITY
Sensors for continuous monitoring of toxic ions, nutrients, and dissolved gases in water
[PB-254834/5] N77-11387
WATER RECLAMATION
Development assessment of wash water reclamation
[NASA-CR-137934] N77-11676
WATER RESOURCES
Sources of organic color in natural waters
N77-11484
Thematic mapping, land use, geological structure and water resources in central Spain — north of Madrid
[E77-10034] N77-11495
Selected priorities: 1978-82. A first-year effort recommending priorities for selected Federal water and related land resource programs in New England
[PB-255890/6] N77-11600
WATER TREATMENT
Thermochemical water splitting: The reverse Deacon reaction and alternatives
[IS-M-63] N77-11541
Selected aspects of waste heat management: A state-of-the-art study
[PB-255697/5] N77-11563
Electrolytic pretreatment unit gaseous effluent conditioning
[NASA-CR-151101] N77-11671
ASTP chemical and microbiological analysis of potable water
[NASA-TM-X-58192] N77-11675
Technical guidelines for public water systems
[PB-255217/2] N77-11928
WATER VAPOR
Water vapor in the lower stratosphere measured from aircraft flight
[NASA-TM-X-71220] N77-11618
WATER WAVES
Time series analysis applied to data from a single ocean wave gauge
[AD-A023821] N77-11769
WAVE DIFFRACTION
Diffraction by wedges and cones
N77-11848
WAVE EQUATIONS
Inverse source problem: Eigenfunction analysis of Bojarski's integral equation
[AD-A025297] N77-11776
WAVE FUNCTIONS
Contributions to WKB theory
N77-11891
WAVE PROPAGATION
Wave propagation in fiber composite laminates, part 2
[NASA-CR-135086] N77-11115
The infinitely long Yagi array of concentric circular loops
N77-11253
Transient analysis of a three-dimensional elastic plate by the Ray grouping technique
N77-11433
An inverse method for determining small variations in propagation speed
[AD-A025296] N77-11467
Mathematical models of acoustic and acoustic-gravity wave propagation in fluids with height-dependent sound velocities
N77-11813
Optics research — report on laser technology and propagation and pollution studies
[AD-A025338] N77-11856
Nonrelativistic electron stream propagation in the solar atmosphere and solar wind: Type 3 bursts
N77-11952
WAVEFORMS
An application of Wiener analysis to human visual psychophysical response
N77-11669
WAVELENGTHS
Automated wavelength selection for flame spectroscopy
[AECL-5311] N77-11137
WEAPONS DEVELOPMENT
New propellants for tactical weapons: Silanes
N77-11190
WEATHER FORECASTING
Tests and evaluations of CLRX, the diagnosis of clear-column radiances
[AD-A023908] N77-11622
Assimilation of surface, upper air, and grid-point data in the objective analysis procedure for a three-dimensional trajectory model
[PB-256082/9] N77-11638
WEATHER MODIFICATION
San Joaquin Valley fog: Attempts at electrical dissipation
[AD-A023715] N77-11637
WEATHERING
Investigation into the influence of natural weathering on the fire resistant property of FFP 5.552 [F-coat]
[FOK-R-1932] N77-11176
WEBS [SUPPORTS]
Stiffness and stress analysis of discretely attached corrugated shear webs with quasi-sinusoidal corrugations
N77-11434
Hardboard-webbed I-beams subjected to short-term loading
[AD-A024507] N77-11465
WEDGES
Diffraction by wedges and cones
N77-11848
WEIGHT [MASS]
The influences of retarding admixtures on volume changes of concrete
[PB-254929/3] N77-11477
WELDABILITY
Study of variables affecting lamellar tearing susceptibility of steels
N77-11152
WELDED STRUCTURES
Weld-bonded titanium structures
[NASA-CASE-LAR-11549-1] N77-11397
WELDING
Weld-bonded titanium structures
[NASA-CASE-LAR-11549-1] N77-11397
WEST VIRGINIA
West Virginia power plant evaluation
[PB-255460/8] N77-11592
WETLANDS
Use of LANDSAT data for natural resources investigation in the lower basin of Danube and Danube Delta — Romania
[E77-10032] N77-11494
WIENER FILTERING
An application of Wiener analysis to human visual psychophysical response
N77-11669
WIND EFFECTS
Some effects of the shearing and veering environmental flow on the internal dynamics and structure of a severe thunderstorm during its mature stage
N77-11633
WIND PRESSURE
Examples of pressure coefficients measured on a tall building
[PB-252416/3] N77-11452
WIND TUNNEL APPARATUS
Description of the model subsonic wind tunnel [MUK] for the large subsonic tunnel [GUK]. Construction, start-up, operation, first results
[DLR-IB-151-75/14] N77-11073
WIND TUNNEL MODELS
Simulation of flight-type engine fan noise in the NASA-Lewis 9X15 anechoic wind tunnel
[NASA-TM-X-73540] N77-11050
Heat-transfer tests on the Rockwell International space shuttle orbiter with boundary-layer trips [OH-54]
[AD-A024553] N77-11098
A device for rapid determination of thermophysical properties of phase-change wind-tunnel models
[NASA-TM-X-3421] N77-11346
WIND TUNNEL NOZZLES
Some supersonic wind tunnel nozzle boundary layer characteristics
[AD-A024980] N77-11018
WIND TUNNEL TESTS
Aerodynamic characteristics of a 0.00563 scale 142-inch diameter solid rocket booster [MSFC model 449 and 480] with side mounted stings in the NASA/MSFC 14-inch trisonic wind tunnel [SA14FA]
[NASA-CR-147645] N77-11000
The AFFDL-Nielsen flow-field study
[AD-A023755] N77-11015
A wind tunnel captive aircraft testing technique
[AD-A023690] N77-11037
An investigation of the aerodynamic characteristics of a 0.00548 scale model [model no. 486] of the space shuttle 146-inch diameter solid rocket booster at angels of attack from 113 deg to 180 deg in the AEDC PWT 4-foot transonic wind tunnel [SA16F]
[NASA-CR-147648] N77-11090
Application of the dual-scatter laser velocimeter in transonic flow research
N77-11225
WIND TUNNEL WALLS
The effect of finite test section length on wall interference in 2-D ventilated wind tunnels
[NLR-MP-75036-U] N77-11071
WIND TUNNELS
Acoustical evaluation of the NASA Langley V/STOL wind tunnel
[NASA-CR-145087] N77-11068
Review on high speed applications of laser anemometry in France and Germany
N77-11222
Laser anemometry and displacement of the measurement point in industrial wind tunnels — in France
[ISL-R-116/75] N77-11370

WINDOWS [APERTURES]
Advanced hardened antenna window materials study 4
[AD-A023944] N77-11128
Rapid electrographic and electrophotographic processes. Lenard window for electrostatic printing tubes — in reproduction equipment
[BMFT-FB-T-76-06] N77-11299
WING FLAPS
Calculation of the longitudinal aerodynamic characteristics of wing-flap configurations with externally blown flaps
[NASA-CR-2705] N77-11006
WING LOADING
Preliminary sizing and performance evaluation of supersonic cruise aircraft
[NASA-TM-X-73936] N77-11031
WING PROFILES
Program for establishing long-time flight service performance of composite materials in the center wing structure of C-130 aircraft. Phase 4: Ground/flight acceptance tests
[NASA-CR-145043] N77-11032
WING TIPS
The inviscid pressure field on the tip of a semi-infinite wing and its application to the formation of a tip vortex
[NASA-CR-2748] N77-11345
WINGS
Application of design data derived from fatigue tests with service-like load sequences for life prediction — wing structures of transport aircraft
[LBF-FB-109/76] N77-11445
WIRE
Analysis of arbitrarily oriented thin wire antenna arrays over imperfect ground planes
N77-11254
WORDS [LANGUAGE]
Finite wordlength in digital signal processing
N77-11255
WORK CAPACITY
Pilot workload and fatigue: A critical survey of concepts and assessment techniques
[NASA-TN-D-8365] N77-11674
WYOMING
Draft environmental assessment of application by ERDA for a special land use permit for use of public lands in Wyoming for in situ coal gasification experiments
[UCID-17011] N77-11572

X

X RAY DIFFRACTION
On the angular divergence of out-going beams in an asymmetric diffraction geometry
[PB-255865/8] N77-11886
X RAY SOURCES
Radiative transfer and gas dynamics in galactic X-ray sources
N77-11957
X RAY SPECTRA
Spectra of Her X-1 near a turn-on in the 35-day cycle
[NASA-TM-X-71213] N77-11935
X RAYS
Charge and mass identification of fission fragments
N77-11110
The theoretical reflectance of X-rays from optical surfaces
[NASA-TN-D-8366] N77-11853
A study of X-ray emission from laser heated plasma
[AD-A025498] N77-11866
XENON
Collisional ionization of xenon atoms in well defined high Rydberg states
N77-11826
Axial xenon redistribution and power shaping in large pressurized water reactors
N77-11845

Y

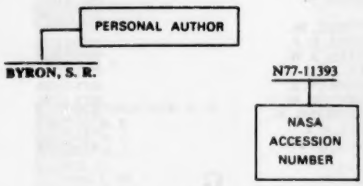
YAGI ANTENNAS
The infinitely long Yagi array of concentric circular loops
N77-11253
YAW
Helicopter yaw axis augmentation investigation
[AD-A024512] N77-11066

Z

ZIRCONIUM ALLOYS
Susceptibility of cold-worked zirconium-2.5 wt. percent niobium alloy to delayed hydrogen cracking
[AECL-5260] N77-11156

PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this Index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.

A

AARNISALO, J. N77-11490
ABARBANEL, S. N77-11771
ABBISS, J. B. N77-11231
ABDEL-HADY, M. N77-11499
ABEL, L. A. N77-11669
ABRAMS, B. S. N77-11278
ABRAMS, M. D. N77-11747
ACAR, M. N77-11846
ACKERSON, B. J. N77-11824
ADAMS, R. N77-11929
ADLER, U. N77-11399
ADRIAN, D. D. N77-11593
AKYILMAZ, M. O. N77-11911
AL-KHAYYAL, F. A. N77-11798
ALBE, F. N77-11375
ALGER, R. S. N77-11022
ALLEN, J. J. N77-11456
ALLEN, J. M. N77-11339
ALLEN, M. A. N77-11941
ALSHEIKH, M. A. A. N77-11912
ALTAN, T. N77-11171
ALVARES, N. S. N77-11022
ALVAREZ, H. N77-11947
AMBROSIUS, B. A. C. N77-11080
ANDERS, W. N77-11300
ANDERSON, D. L. N77-11462
ANDERSON, L. B. N77-11548
ANDERSON, W. W. N77-11548
ANDRES, F. M. N77-11909
ANTAR, B. N. N77-11344
ANTHONI, J. F. N77-11724
ANTOLOVICH, S. D. N77-11172
ARANOVICH, J. N77-11547
ARMBRUSTER, J. T. N77-11512
ARNOLD, J. R. N77-11039
ARNOLD, R. G. N77-11692
ARPASI, D. J. N77-11057
ARROWSMITH, J. M. N77-11453
ARZATE, J. T. N77-11498
ASHIZAWA, M. N77-11036
ASHLEY, R. W. N77-11137
ATMAR, J. W., III N77-11752
AUSTIN, S. S. N77-11847
AXNAES, I. N77-11865
AYIKU, M. N. B. N77-11418
AYOUB, M. M. N77-11520

B

BABBUSH, C. A. N77-11655
BABUSKA, I. N77-11766
BACHALO, W. D. N77-11224
BAGG, T. C. N77-11906
BAILEY, C. B. N77-11721
BAILEY, S. N. N77-11457
N77-11472
BAILLET, G. N77-11639
BAILLY, R. N77-11234
BAKER, W. E. N77-11479
BALAS, E. N77-11806
BALWANZ, W. W. N77-11219
BANCILHON, F. M. N77-11698
BANHARNSUPAVAT, S. N77-11360
BANKS, B. A. N77-11655
BANTA, E. D. N77-11250
BARBER, H. B. N77-11962
BARDWELL, S. J. N77-11863
BARNES, F. H. N77-11232
BARR, R. E. N77-11657
BARTICK, H. N77-11207
BARTOS, J. L. N77-11153
BARTOW, J. E. N77-11280
BASHKIN, S. N77-11138
BASIL, I. T. N77-11024
BATEMAN, J. B. N77-11663
BATY, D. L. N77-11044
BEAUFRERE, A. N77-11201
BECHTEL, R. T. N77-11103
BECKER, D. N77-11270
BECKER, J. A. N77-11305
BECKER, M. N77-11575
BECKER, R. H. N77-11935
BEDNORZ, K. N77-11300
BEDROSS, G. M. N77-11524
BELSHER, J. F. N77-11700
BENDA, H. N77-11303
BENDEN, R. S. N77-11154
BENNETT, C. B., JR. N77-11131
BENNETT, D. L. N77-11332
BENNETT, L. C. N77-11124
BENSON, J. L. N77-11949
BENTON, A. W. N77-11779
BEREZINSKIY, V. S. N77-11946
BERGER, B. B. N77-11593
BERKOWITZ, S. N77-11735
BERNDES, G. N77-11304
BERNING, D. W. N77-11394
BERNSTEIN, M. H. N77-11133
BEZLER, P. N77-11334
BHUSAN, B. N77-11429
BIERMAN, G. J. N77-11763
BIGGERS, J. C. N77-11390
BJERKAAS, A. W. N77-11769
BLACK, J. M. N77-11296
BLAHA, G. N77-11628
BLAKNEY, D. F. N77-11045
BLANC, R. P. N77-11747
BLEISTEIN, N. N77-11467
N77-11776
BLESSING, G. V. N77-11385
BLORE, R. A. N77-11316
BLUE, J. N77-11389
BOES, E. C. N77-11537
BOETTINGER, W. J. N77-11886
BOLDT, E. A. N77-11935
BOND, G. F. N77-11660
BONGAARTS, A. L. M. N77-11885
BORISENKO, I. G. N77-11076
BORNSTEIN, J. A. N77-11337
BOTT, J. F. N77-11139
BOUIS, X. N77-11228
N77-11349
N77-11370
N77-11371
BOURQUIN, R. D. N77-11884
BOWEN, R. N77-11207
BOWERS, J. F., JR. N77-11592
BOWMAN, J. S. N77-11647
BOX, G. E. P. N77-11773
BOYD, F. E. N77-11736
BOYD, R. M. N77-11573
BOYER, R. S. N77-11730
BRANGER, J. N77-11441
BRASHEARS, M. R. N77-11002
BRAUN, C. N77-11201
BRAZEL, J. P. N77-11128
BREITSTEIN, L. N77-11571
BRIGHAM, G. A. N77-11820
BRILEY, W. R. N77-11345
BRISTOL, T. W. N77-11822
BROCKMANN, C. E. N77-11491
BROWN, C. E. N77-11013
BROWN, G. V. N77-11213
BROWN, S. C. N77-11063
BROWNLEE, E. N77-11699
BRULLE, R. V. N77-11536
BRUMAGHIM, S. H. N77-11667
BRUMM, G. A. N77-11524
BRUTON, W. M. N77-11057
BUBE, R. H. N77-11547
BUCH, F. N77-11547
BUCHELE, D. R. N77-11366
BUCK, V. N77-11129
BUENSOW, L. N77-11920
BUGAYEV, B. P. N77-11019
BULL, H. L. N77-11404
BUNDY, D. H. N77-11601
BUNSHAH, R. F. N77-11166
BURBACH, J. N77-11177
BURKE, H. H. K. N77-11608
BURROUS, C. N. N77-11063
BURTON, R. R. N77-11646
N77-11652
BURTON, R. W. N77-11283
BUSCHING, H. W. N77-11562
BUSH, D. A. N77-11907
BUSH, T. W. N77-11511
BUSHEY, R. W. N77-11454
BUSHNELL, D. L., JR. N77-11630
BUTLER, G. A. N77-11014
BUTLER, R. W. N77-11037
BYERS, D. C. N77-11106
BYRD, J., JR. N77-11545
BYRN, N. R. N77-11783
BYRON, S. R. N77-11393

C

CALEDONIA, G. E. N77-11854
CALKINS, W. L. N77-11702
CAMERON, A. N77-11178
CAMPBELL, A. D. N77-11451
CANAVIN, J. R. N77-11095
N77-11096
CANNADAY, R. L. N77-11033
CANNADY, M. D. N77-11531
CANNON, W. A. N77-11197
CAPUTO, B. N77-11140
CARD, W. H. N77-11551
CARLSON, R. E. N77-11767
CARMICHAEL, J. N77-11569
CARMICHAEL, R. N77-11510
CARMONA, F. N77-11117
CARPENTER, S. H. N77-11476
CARROLL, S. L. N77-11200
CARSON, G. T., JR. N77-11069
CARTA, F. O. N77-11412
CARTER, L. F. N77-11556
CARVER, D. B. N77-11098
CATTANEO, L. E. N77-11459
CELOTTA, R. J. N77-11630
CHALIFOUR, H. R. N77-11309
CHAMIS, C. C. N77-11442
CHAMPINE, R. A. N77-11001
CHAN, K. K. N77-11848
CHAN, S. T. K. N77-11092
CHANDRA, N. N77-11830
CHANG, F. W. N77-11320
CHANG, J. C. I. N77-11335
CHANG, P. T. N77-11633
CHANG, T. S. N77-11880
CHANG, Y. C. N77-11794
CHAPMAN, D. N77-11544
CHAPPELL, M. S. N77-11411
CHARWAT, A. F. N77-11365
CHATTERJEE, A. N77-11932
CHATTOT, J. J. N77-10997
CHAY, S. C. N77-11550
CHAYT, K. A. N77-11748
CHEN, G. T. H. N77-11132
CHEN, I. N. N77-11750
CHEN, L. L. C. N77-11333
CHEN, S. M. N77-11404
CHEN, Y. K. N77-11750
CHERRY, W. B. N77-11797
CHEVILLAT, P. R. N77-11705
CHI, C. J. N77-11879
CHICKERING, J. B. N77-11526
CHICOTKA, R. J. N77-11872
CHIEN, J. C. N77-11580
CHILDERS, K. N77-11129
CHISUM, G. T. N77-11658

CHODZKO, R. A. N77-11659
CHOMOS, G. J. N77-11395
CHOU, L. C. N77-11295
CHRISTOFIDES, N. N77-11002
CIARVELLA, M. J. N77-11740
CIGNOLI, F. N77-11840
CLARE, H. N77-11245
CLARK, B. J. N77-11246
CLARK, J. W. N77-11052
CLARK, R. M. N77-11923
CLARK, W. E. N77-11913
CLARKE, N. P. N77-11066
CLARKE, P. J. N77-11644
CLAUER, A. H. N77-11603
CLAYTON, R. M. N77-11162
CLEVELAND, W. B. N77-11198
CLEVENSON, S. A. N77-11693
CLINE, V. A. N77-11666
CLOUETTE, G. L. N77-11225
COGHE, A. N77-11091
COHEN, J. K. N77-11245
COHEN, N. S. N77-11776
COLE, K. N77-11199
COLEMAN, C. E. N77-11544
COLEMAN, R. G. N77-11156
COLOMBO, G. V. N77-11005
COLUCCI, A. V. N77-11671
CONTRERAS VILLASENOR, L. E. N77-11590
CONWAY, G. S. N77-11712
COOPER, A. B., III N77-11041
COOPER, B. K. N77-11704
COOPER, S. N77-11821
COOTE, N. C. T. N77-11489
CORBLY, D. M., JR. N77-11842
CORNISH, R. H. N77-11432
CORSIGLIA, V. R. N77-11126
COTTINGHAM, J. G. N77-11390
COULBERT, C. D. N77-11539
COVAULT, D. O. N77-11197
COX, P. A. N77-11562
CRAMER, H. E. N77-11464
CRANSTON, R. J. N77-11592
CRAPO, B. J. N77-11723
CREASON, J. P. N77-11223
CREEDON, J. F. N77-11576
CREEL, T. R., JR. N77-11397
CRESS, D. H. N77-11346
CRESSIE, N. N77-11519
CRIST, S. C. N77-11770
CROSS, F. F. N77-11706
CRUMP, F. P. N77-11395
CSIKOS, I. N77-11645
CULP, R. L. N77-11619
CULVER, C. N77-11928
CULVER, W. H. N77-11218
CURREN, A. N. N77-11027
CURRIN, D. D. N77-11295
CURRY, R. E. N77-11456
CURTIS, H. B. N77-11030
N77-11529

D

DALMAN, G. C. N77-11311
DANBERG, J. E. N77-11018
DANCER, A. N77-11196
N77-11639
N77-11640
DANIEL, I. M. N77-11114
N77-11115
N77-11116
DANIELL, R. E., JR. N77-11953
DASILVA, J. R. G. N77-11883
DAUDPOTA, Q. I. N77-11232
DAVIS, J. L., JR. N77-11331
DAWSON, C. W. N77-11414
DEAL, P. L. N77-11001
DEAN, R. L. N77-11562
DEAN, W. G. N77-11212
DEBELLEVAL, J. F. N77-11238
DEES, J. V. N77-11077
DEIVANAYAGAM, S. N77-11520
DELASCUEVAS, N. N77-11495
DELERY, J. N77-10997
DELONGUEVILLE, Y. N77-11204
DELSEMME, A. H. N77-11937
DELUCCIA, J. J. N77-11146
DEMARCHI, J. N. N77-11065
DEMPSEY, R. M. N77-11380
DEMPSEY, T. K. N77-11666
DENTON, J. C. N77-11560
DEPAUW, J. F. N77-11268
DESOBRY, G. E. N77-11841
DESROSIERS, D. N77-11273
DEVRIERE, F. N77-11639
N77-11641
DEWEY, C. F., JR. N77-11237
DEYOUNG, T. F. N77-11878
DICKINSON, R. M. N77-11269
DIEHL, L. A. N77-11056
DIESINGER, W. H. N77-11188
DIETRICH, D. A. N77-11050
DIMOTAKIS, P. E. N77-11230
DIPIAZZA, P. S. N77-11284
DIXON, C. J. N77-11017
DLOUHY, F. N77-11301
DOANE, D. A. N77-11810
DONG, W. K. N77-11661
DONN, B. N77-11945
DONNELLY, R. G. N77-11534
DORAZIO, A. J. N77-11410
DORIATH, G. N77-11190
DOSSANTOS, R. N77-11240
DOSTERT, B. H. N77-11731
DOWELL, R. T. N77-11649
DOWSON, D. N77-11400
DRISCOLL, J. F. N77-11236
N77-11326
DRUCKER, E. E. N77-11551
DRUET, S. N77-11234
DUBEY, R. K. N77-11428
DUCOFF, M. R. N77-11278
DUDLEY, J. D. N77-11058
DUDLEY, W. A. N77-11419
DUNBAR, R. M. N77-11723
DUNCAN, L. M. N77-11077
DUNN, P. N77-11618
DURAO, D. F. G. N77-11246
DURBIN, P. A. N77-11578
DURGIN, F. H. N77-11452
DURRAN, D. A. N77-11395
DURRANI, T. S. N77-11232
DWYER, R. F. N77-11781

E

EAST, I. F. N77-11226
EASTERLY, D. G. N77-11584
EASTMAN, D. N77-11028
EASTMAN, L. F. N77-11311
EATOUGH, D. J. N77-11590
ECKERLE, K. L. N77-11381
ECKERT, J. N77-11829
ECKERT, J. A. N77-11601
EDDINGFIELD, D. L. N77-10996
EDMISTON, R. D. N77-11821
EDSE, R. N77-11060
EDWARDS, F. M. N77-11837
EDWARDS, R. N77-11207
EGGINS, P. L. N77-11227
EKSTEDT, T. W. N77-11390
ELDRIDGE, R. N77-11569
ELLINGWOOD, B. N77-11471
ELSPAS, B. N77-11730
ENGLE, R. M. N77-11478
ENSOR, D. S. N77-11384
ERICKSON, H. H. N77-11649
ERICKSON, J. M. N77-11683
ERICSON, W. A. N77-11796
ERVENS, W. N77-11177
ESKER, D. W. N77-11107
ESPARZA, E. D. N77-11480
ETSION, I. N77-11401
N77-11402
EVANS, T. G. N77-11895
EWELL, J. J. N77-11077

F

FAGOT, H. N77-11369
N77-11375
FAHRENBRUCH, A. N77-11547
FAIN, P. R. N77-11665
FAINBERG, J. N77-11947
FAIRALL, C. W. N77-11637
FAIRHURST, G. V. N77-11737
FALLER, K. N77-11497
FANG, J. C. N77-11359
FANG, S. M. N77-11323
FARLEY, E. P. N77-11174
FARRAR, A. N77-11293
FARRELL, W. T. N77-11898
FASSO, G. E. N77-11070
FATTAL, S. G. N77-11459
FELDMAN, K. T. N77-11340
FELDMAN, S. I. N77-11361
FELIX, L. G. N77-11596
FELTEN, E. J. N77-11154
FENG, T. Y. N77-11749
N77-11750
FENWICK, E. H. N77-11799
FERBER, K. M. N77-11353
FERRI, A. N77-11061
FERRITTO, J. M. N77-11458
FETTERMAN, D. E., JR. N77-11031
FEWELL, L. L. N77-11111
FICHTEL, C. E. N77-11965
FIELDS, D. R. N77-11839
FIELDS, S. A. N77-11853
FINDLEY, R. W. N77-11583
FISCHER, D. D. N77-11573
FISCHER, H. N77-11305
FISCHER, R. W. N77-11034
FISHER, B. D. N77-11001
FITZENREITER, R. J. N77-11947
FITZPATRICK, W. N. N77-11091
FLEISCHAUER, P. D. N77-11926
FLEMING, W. S. N77-11551
FLOT, R. N77-11009
FOGLEMAN, W. W. N77-11387
FOLEY, J. D. N77-11699
FOMINOV, A. M. N77-11614
FORREST, L. A. N77-11524
FOURNEY, M. E. N77-11365
FOURNIER, A. N77-11187
FOX, D. G. N77-11318
FRANCIS, M. S. N77-11014
FRANCIS, P. H. N77-11127
FRANK, G. N77-11699
FRANKE, R. N77-11639
N77-11640
FRANKEL, M. N77-11583
FRASER, G. J. N77-11613
FRAZER, J. W. N77-11662
FREY, J. N77-11311
FRIEDMAN, E. N77-11569
FROBOESE, M. N77-11196
FROESSLING, N. N77-11248
FROST, P. J. N77-11725
FUNKE, M. F. N77-11388

G

GAILLARD, A. W. K. N77-11668
GALE, J. G. N77-11427
GALLAGHER, J. N77-11478
GALLIPPI, M. J. N77-11036
GALLOWAY, G. J. N77-11610
GANDAHL, R. N77-11917
GANESH, S. N77-11152
GARDNER, M. A. N77-11831
GARLOW, J. R. N77-11877
GARTH, J. C. N77-11832
GARTNER, W. B. N77-11674
GAUGLER, R. E. N77-11439
GAUL, E. J. N77-11277
GAVLIN, N. L. N77-11473
GAWTHROP, P. J. N77-11756
GEHLEN, P. C. N77-11164
GENTLE, R. C. N77-11178
GEORGE, C. A. N77-11714
GERHARZ, J. J. N77-11446
N77-11447
GERHOLD, D. N77-11347
GERRARD, M. N77-11740
GHEZZI, U. N77-11245
GIBSON, J. S. N77-11045
GIEDT, R. R. N77-11395
GIERALTOWSKI, G. F. N77-11719
GIFFORD, L. N., JR. N77-11474
GILLHAM, J. K. N77-11180
GILLINGHAM, K. K. N77-11645
GILREATH, M. C. N77-11266
GIVEN, P. H. N77-11535
GLAISTER, D. H. N77-11648
GLENN, S. W. N77-11078
GODFREY, T. G. N77-11534
GODFRIED, L. M. N77-11122
N77-11123
N77-11176
GOEBEL, F. L. N77-11035
GOEBEL, J. A. N77-11160
GOLBRAYKH, I. G. N77-11615
GOLDBERG, R. A. N77-11635
GOMER, F. E. N77-11686
GOOCH, J. P. N77-11596
GOODE, M. W. N77-11033
GOODMAN, J. W. N77-11700
GOODWIN, F. K. N77-11006
GORAK, R. J. N77-11026
GORDON, J. L. N77-11444
GOSSETT, J. M. N77-11577
GOTLIEB, P. N77-11064
GOTTLIEB, D. N77-11771
GOULARD, R. N77-11233
GOVINDARAJULU, Z. N77-11788
N77-11789
GRANDE, C. R. N77-11206
GRANT, I. N77-11232
GRANT, R. E. N77-11571
GRAY, L. N. N77-11556
GREATED, C. A. N77-11232
GRECCO, W. L. N77-11932
GREEN, A. T. N77-11460
GREENFIELD, G. R. N77-11800
GREENSTEIN, T. N77-11556
GREGORY, C. N77-11517
GREIDANUS, P. J. N77-11195
GRIFFITH, W. C. N77-11412
GRIMES, G. C. N77-11127
GROSS, D. N77-11798
GROSSMAN, R. W. N77-11727
GROVE, D. E. N77-11739
GUAGLIARDO, J. L. N77-11601
GUENTHER, B. N77-11618
GULDEN, M. E. N77-11184
GURIN, L. S. N77-11785
GUSTAFSON, D. E. N77-11838

H

HADDOCK, F. T. N77-11947
HAERTIG, J. N77-11371
HAFNER, E. N77-11310
HAHN, A. W. N77-11657
HAHN, G. T. N77-11164
HAISCH, H. F., JR. N77-11262
HALL, A. W. N77-11001
HALL, G. F. N77-11345
HALLIDAY, R. A. N77-11501
HAMERSMA, J. W. N77-11581
HAMLIN, R. L. N77-11650
N77-11664
HAMMERLING, F. D. N77-11720
HAMROCK, B. J. N77-11400
N77-11402
HANAU, H. N77-11404
HANCY, J. P. N77-11349
N77-11370
N77-11406
HANDSCHUMACHER, D. W. N77-11517
HANING, R. K. N77-11065
HANSEN, R. J. N77-11452
HANSON, R. J. N77-11772
HAOUR, G. N77-11162
HARDIN, L. W. N77-11412
HARDIN, T. C. N77-11200
HARDY, D. A. N77-11961
HARMON, T. G. N77-11452
HARRINGTON, A. N77-11313
HARRIS, R. F. N77-11042
HARRIS, S. J. N77-11278
HARTEN, A. N77-11764
HARTLE, R. E. N77-11944
HARTMANN, C. R. P. N77-11732
HARTWIG, R. C. N77-11795
HARTZELL, R. H. N77-11662
HARTZUIKER, J. P. N77-11070
HARVEY, D. P. N77-11684
HARVILL, W. E. N77-11032
HARWIT, M. N77-11939
HASSELBLAD, V. N77-11576
HATCHETT, S. P., II N77-11957
HAUCK, M. R. N77-11924
HAUG, G. N77-11307
HAUSER, J. N77-11922
HAWLEY, A. V. N77-11036
HAYASHI, S. N77-11488
HAYES-ROTH, F. N77-11759
HAYES, R. D. N77-11734
HEALD, K. A. N77-11926
HEALY, J. B., JR. N77-11577
HEIDMANN, M. F. N77-11050
N77-11052
HEIDNER, R. F., III N77-11139
HEIN, G. F. N77-11908
HEIN, L. A. N77-11403
HEINRICH, K. F. J. N77-11378
HELFFENSTEIN, H. L. N77-11451
HELMER, F. T. N77-11896
HEMPHILL, J. M., JR. N77-11897
N77-11899
HENDRICK, R. E. N77-11825
HENNIGER, H. N77-11391
HERBELIN, J. M. N77-11833
HERBETTE, G. N77-11406
HERMAN, J. R. N77-11635
HERSHALL, P. G. N77-11701
HERSHEY, R. L. N77-11818
HERZMANN, F. N77-11391
HESSER, J. E. N77-11936
HESSMAN, F. W. N77-11035
HEWITT, H. J. N77-11316
HEWITT, J. S. N77-11443
HIBAR, J. R. N77-11605
HIGGINS, T. H. N77-11818
HILDEBRAND, G. N77-11929
HILSENRATH, E. N77-11618
HILTEN, J. S. N77-11367
HIRSH, R. S. N77-11342
HIRTH, A. N77-11235
HIXON, C. W. N77-11673
HODGSON, J. W. N77-11200
HOEBEDA, P. N77-11920
HOFER, K. E., JR. N77-11124
N77-11126
HOFFMAN, W. C. N77-11030
HOHL, J. H. N77-11292
HOIST, G. C. N77-11682
HOLGUIN, A. N77-11502
HOLL, M. M. N77-11622
HOLLEY, H. N77-11497
HOLLISTER, W. M. N77-11030
HOLMAN, F. F. N77-11046
N77-11047
N77-11048
N77-11049
HOLMES, T. N77-11933
HOLT, S. S. N77-11935
HOLTZ, M. N77-11025
HOLZAPFEL, W. N77-11391
HOPKINS, C. O. N77-11687
HOPPE, K. H. N77-11306
HORIKAWA, S. N77-11488
HORNG, C. T. N77-11868
HORROX, A. J. W. N77-11158
HORTON, W. H. N77-11440
HOSSAIN, A. N77-11492
HOUBEN, J. N77-11348
HOUSKA, K. H. N77-11307
HOWARD, J. B. N77-11511
HOWARD, M. L. N77-11077
HOWARD, P. A. N77-11336
HSIUNG, C. Y. N77-11876
HSU, K. W. N77-11261
HU, E. W. N77-11852
HUBER, P. N77-11303
HUCK, F. O. N77-11099
HUD, G. C. N77-11809
HUDNALL, J. M. N77-11736
HUEBNER, R. H. N77-11630
HUFFMAN, G. D. N77-11408
HUGENSCHMIDT, M. N77-11368
N77-11392
HUGHES, M. M. N77-11631
HUNT, M. S. N77-11938
HUNTER, W. L. N77-11167
HURTEAU, M. N77-11137
HUSKAMP, J. C. N77-11722
HUTCHENREUTHER, A. J. N77-11524
HUTFILZ, J. M. N77-11322
HYMAN, J. M. N77-11764

I

INTANO, G. P. N77-11066
IONESCU, T. V. N77-11754
IRANI, K. B. N77-11698
IVERSON, M. S. N77-11836
IVES, J. D. N77-11514
IVES, L. K. N77-11168
IVEY, E. S. N77-11814

J

JACKSON, D. A. N77-11227
JAEGGY, B. C. N77-11012
JAMET, F. N77-11376
N77-11406
JANI, Y. K. N77-11960
JANKOVIC, M. S. N77-11438
JANSEN, C. J. N77-11072
JANUS, A. R. N77-11822
JARVIS, A. N. N77-11584
JARVIS, R. G. N77-11723
JENG, Y. S. N77-11625
JENKINS, D. W. N77-11595
JENSEN, F. R. N77-11109
JERNQVIST, L. F. N77-11248
JERSKEY, T. N. N77-11578
JHA, S. N77-11389
JOCHIM, E. F. N77-11094
JOHANSSON, T. G. N77-11248
JOHNSON, D. A. N77-11224
JOHNSON, D. P. N77-11379
JOHNSON, K. H. N77-11888
JOHNSON, S. J. N77-11625
JOHNSON, S. M. N77-11530
JOHNSON, W. H. N77-11022
JONES, B. F. N77-11607
JONES, J. C. N77-11598
JONES, R. E. N77-11721
JORGE, H. F. V. N77-11845
JOSEPHSON, W. A. N77-11780
JUDD, G. W. N77-11822
JUERGENS, W. N77-11306
JURET, J. N77-11819

K

KACHNOWSKI, T. A. N77-11147
KALENTY, C. R. N77-11893
KALNITSKY, K. C. N77-11396
KAN, E. P. N77-11505
KANO, H. N77-11745
KAPOOR, V. J. N77-11875
KARAFIATH, L. L. N77-11416
KARCHMER, A. N77-11053
KARLSSON, S. K. F. N77-11248
KARNAZES, P. A. N77-11713
KARO, A. M. N77-11831
KARPOVICH, P. A., C.J. N77-11410
KARU, Z. S. N77-11212
KAUFMAN, A. N77-11439
KAUSCHE, H. N77-11306
KAWAM, A. N77-11468
KEITZ, E. N77-11569
KELLEY, R. P. N77-11768
KELLNER, R. N77-11694
KEMMERER, A. J. N77-11497
KEMP, M. A. N77-11931
KENNEDY, D. A. N77-11014
KENNEDY, G. N77-11699
KENNEDY, H. V. N77-11874
KENNEDY, K. W. N77-11520
KERSHENBAUM, A. N77-11260
KERSLAKE, W. R. N77-11101
KERSTEN, P. R. N77-11259
KEYFITZ, B. N77-11764
KHANDHERIA, J. N77-11703
KHARARJIAN, H. A. N77-11568
KHAZZOOM, J. D. N77-11561
KIDWELL, J. R. N77-11046
N77-11047
N77-11048
N77-11049
KIESSLING, G. N77-11306
KILLUS, J. P. N77-11578
KING, W. S. N77-11355
KINNEY, W. A. N77-11813
KIRALY, L. J. N77-11442
KIRK, B. L. N77-11765
KISSEL, R. R. N77-11079
KISSELL, F. N. N77-11386
KIZER, J. A. N77-11032
KLAMERUS, L. J. N77-11297
KLEINMAN, D. L. N77-11030
KLEMAS, V. N77-11486
KLEMME, D. E. N77-11643
KLICH, G. F. N77-11067
KLOEHN, W. N77-11189
KNAIZUK, J., JR. N77-11732
KNAUS, E. N77-11182
KNEZOVICH, F. M. N77-11617
KNIFFEN, D. A. N77-11965
KNUTH, D. E. N77-11790
KOCHAROV, G. Y. N77-11954
KOERBER, G. N77-11371
KOEVERMANS, W. P. N77-11072
KOHN, E. S. N77-11858
KOLB, J. O. N77-11534
KOLDEWYN, W. A. N77-11807
KOLNSBERG, H. J. N77-11585
KOOI, J. W. N77-11352
KOURTIDES, D. A. N77-11111
KOUYOUMJIAN, R. G. N77-11282
KOVAL, A. D. N77-11075
KOVICH, G. N77-11008
KRAUTH, G. N77-11205
KREIM, W. J. N77-11052
KROMMES, J. A. N77-11862
KRUGER, J. N77-11169
N77-11170
KRUSINGER, A. E. N77-11627
KUECHEMANN, D. N77-11070
KUESTER, E. F. N77-11851
KULWICKI, P. V. N77-11043
KUMAR, V. N77-11291
KUNCHAL, K. N77-11207
KUNHARDT, E. E. N77-11861
KUO, B. N77-11426
KURIYAMA, M. N77-11886
KWOK, M. A. N77-11395
N77-11833

L

LACOMBE, D. J. N77-11290
LACONTI, A. B. N77-11380
LACROIS, A. H. N77-11120
N77-11448
N77-11449
LADING, L. N77-11243
LAGRAFF, J. E. N77-11551
LAI, H. L. N77-11805
LAIRD, B. L. N77-11598
LAMB, B. G. N77-11578
LAMB, M. N77-10995
LANCEVICH, E. J. N77-11744
LANE, G. N77-11281
LAPIDE, L. N77-11900
LAREW, H. G. N77-11468
LARRABEE, R. D. N77-11858
LASSAK, L. N77-11306
LASTOCHKIN, A. N. N77-11615
LAU, C. K. P. N77-11784
LAU, K. F. N77-11873
LAUGHRIDGE, F. I. N77-11022
LAUMANN, E. A. N77-11398
LAWHERN, R. A. N77-11082
LAX, P. D. N77-11764
LAZARUS, E. A. N77-11209
LE CAM, L. N77-11787
LEAHY, M. P. N77-11930
LEATHERWOOD, J. D. N77-11666
LEAVENWORTH, R. S. N77-11421
N77-11422
LEBALLEUR, J. C. N77-10997
LEDERER, P. S. N77-11367
LEE, A. L. N77-11092
LEE, C. A. N77-11311
LEE, C. C. N77-11749
LEE, J. H. N77-11136
LEE, J. K. N77-11766
LEE, K. H. N77-11251
LEFTIN, M. N77-11276
LEGAKIS, P. I. N77-11753
LEHMAN, G. M. N77-11036

LEITH, J. R. N77-11673
LEMING, T. N77-11497
LEMKEY, F. D. N77-11165
LEONARD, D. A. N77-11140
LESH, J. R. N77-11715
LESLIE, S. A. N77-11675
LEVERETT, S. D., JR. N77-11644
N77-11650
N77-11652
LEVIE, H. W. N77-11151
LEVINE, D. M. N77-11294
LEVINE, S. R. N77-11155
LEWIS, C. H. N77-11580
LEWIS, G. E. N77-11064
LEWIS, N. D. N77-11812
LI, S. S. N77-11889
LIAN, K. T. N77-11286
LIANG, J. C. N77-11285
LIBER, T. N77-11114
N77-11115
N77-11116
LIBUHA, J. J. N77-11820
LIEBMAN, M. N77-11273
LIKINS, P. W. N77-11755
LILIENFELD, P. N77-11681
LILJA, B. N77-11919
LIM, I. C. N77-11173
LINDHOUT, J. P. F. N77-11010
N77-11348
LINDSEY, J. N. N77-11649
LINK, L. E., JR. N77-11519
LIPPITT, M. W., JR. N77-11660
LIPTON, R. J. N77-11733
LISHER, B. J. N77-11648
LITTLE, D. N. N77-11456
LITTLE, L. J. N77-11064
LITTLE, M. J. N77-11077
LIU, C. H. N77-11816
LIU, M. K. N77-11599
LIU, Y. N. N77-11425
LO, C. F. N77-11225
LOCHOW, R. N77-11562
LOCKEN, J. N77-11544
LOCKWOOD, W. L. N77-11893
LOEVE, W. N77-11746
LONG, H. R. N77-11197
LONGLEY, A. G. N77-11272
LONGOBARDI, R. J. N77-11711
LOPESCARDOZO, E. N77-11724
LOQUERCIO, P. N77-11583
LORENZ-MEYER, W. N77-11070
LORENZ, H. P. N77-11306
LOTTHAMMER, R. N77-11299
LOVELESS, F. M., JR. N77-11729
LOWAK, H. N77-11445
LOWE, T. J. N77-11777
LUCIA, F. N77-11273
LUDWIG, E. D. N77-11027
LUEBBERS, R. J. N77-11282
LUHMANN, J. G. N77-11966
LUKASZEWSKI, D. A. N77-11077
LUKESH, G. W. N77-11802
LUNDRY, J. L. N77-11005
LUX, B. N77-11162
LYNCH, M. P. N77-11598
LYON, C. J. N77-11421
N77-11422
LYSTAD, H. D. N77-11038
N77-11040
LYTTON, R. L. N77-11476

M

MAAS, L. D. N77-11694
MACKENZIE, J. D. N77-11130
MACKENZIE, W. F. N77-11646
MAENTYSALO, S. N77-11668
MAGELSSEN, G. R. N77-11952
MAHAGAOKAR, U. N77-11135
MANDEL, G. N77-11901
MANLEY, O. P. N77-11866
MANN, B. J. N77-11564
MANOOGIAN, D. V. N77-11265
MANTENIEKS, M. A. N77-11104
MARCHANT, G. H., JR. N77-11596
MARCI, G. N77-11431
MARGASON, R. J. N77-10998
MARINO, C. M. N77-11493
MARK, W. D. N77-11034
MARKHAM, D. N77-11580
MARKOWSKI, G. R. N77-11384
MARSH, S. L. N77-11578
MARSHALL, D. E. N77-11761
MARSHALL, J. A. N77-11550
MARSHALL, R. D. N77-11672
MARTIN, T. D. N77-11808
MARTINEZ, J. M., II N77-11654
MARUYASU, T. N77-11488
MARVIN, R. S. N77-11214
N77-11216
MASCUNANA, I. N77-11466
MASEN, C. N77-11281
MATHESON, H. N77-11379
MATHIEU, J. N77-11009
MATTHEWS, J. A. N77-11454
MAULARD, J. N77-11238
MAYHAN, K. G. N77-11657
MAYO-WELLS, J. F. N77-11367
MAYO, M. H. N77-11033
MAZUMDAR, J. N77-11443
MAZUMDAR, M. N77-11550
MAZUMDER, P. N77-11881
MCBEE, C. L. N77-11170
MCCAIN, J. D. N77-11597
MCCARTHY, J. F., JR. N77-11042
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MCCORMICK, F. N77-11468
MCCULLOCH, C. M. N77-11518
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MCELROY, D. L. N77-11534
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MCKEEN, R. G. N77-11437
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MCKINNIS, D. E. N77-11859
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MCNEANY, J. L. N77-11720
MCNICKLE, D. C. N77-11797
MEAD, W. N77-11572
MEADORS, H. C., JR. N77-11762
MEINERI, G. N77-11651
MELFI, S. H. N77-11601
MELLING, A. N77-11246
MELMAN, P. N77-11330
MENDELL, W. W. N77-11950
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MENDILLO, M. N77-11621
MENEGHINI, R. N77-11294
MERCK, W. N77-11348
MERRILL, G. L. N77-11054
MERRITT, A. C. N77-11327
MERRITT, J. H. N77-11662
MERTENS, G. N77-11270
MERZKIRCH, W. N77-11244
MESEROLE, F. B. N77-11607
MESICH, F. G. N77-11607
METCALFE, A. G. N77-11184
METTLER, S. C. N77-11240
MEYER, E. N77-11304
MICHAEL, J. V. N77-11136
MICHALIK, T. R. N77-11844
MICHELS, H. H. N77-11629
MIDDEN, R. E. N77-11069
MIDDLEKAMP, L. C. N77-11271
MIDDLETON, W. D. N77-11005
MIELCZAREK, S. R. N77-11630
MIELE, A. N77-11463
MIJARES-LOPEZ, C. J. N77-11134
MIKOLOWSKY, W. T. N77-11925
MILES, J. H. N77-11051
MILES, R. B. N77-11239
MILLAR, D. A. J. N77-11411
MILTNER, E. N77-11927
MIRKIN, B. R. N77-11615
MIRTICH, M. J. N77-11101
MISHIN, V. M. N77-11616
MISLAN, J. P. N77-11137
MITCHELL, D. N77-11699
MITCHELL, R. J. N77-11145
MODDARESS, D. N77-11224
MOFFITT, T. P. N77-11007
MOHANTY, S. N. N77-11716
MOLL, K. D. N77-11602
MOLLARD, F. N77-11162
MOONEY, V. N77-11916
MOORE, J. S. N77-11583
MOORE, R. D. N77-11008
MOOZ, W. E. N77-11023
MORAWSKI, P. N77-11414
MORGAN, H. L. N77-11904
MORIARTY, J. N77-11560
MORRISON, S. R. N77-11174
MUELLER, L. A. N77-11105
MUELLER, R. N77-11073
MUENCH, R. K. N77-11409
MUNOZ-CANDELARIO, R. N77-11200
MURPHY, M. R. N77-11674
MYERS, W. N. N77-11403
MYKLEBUST, R. L. N77-11378

N

NAEAETAENEN, R. N77-11668
NAGPAL, V. N77-11171
NAKAJIMA, I. N77-11488
NAKANO, T. N77-11488
NEAL, B. F. N77-11472
NEERGAARD, J. R. N77-11853
NEIHOF, R. A. N77-11643
NELKEN, M. N77-11566
NELSON, A. N. N77-11834
NELSON, C. W. N77-11193
NELSON, L. Y. N77-11393
NELSON, W. C. N77-11576
NEREM, R. M. N77-11664
NEWBURY, D. E. N77-11378
NEWCOME, D. L. N77-11739
NIELSEN, G. I. T. N77-11016
NIELSEN, J. N. N77-11006
NIETZOLD, T. P. N77-11275
NOLAN, M. E. N77-11380
NORCO, J. E. N77-11588
NORUM, T. D. N77-11816
NOVICK, W. A. N77-11264
NWANKWO, J. N. N77-11591

O

OBRIEN, V. N77-11351
OBRYAN, T. C. N77-11033
OCHIAI, H. N77-11488
ODEN, J. T. N77-11766
ODONNELL, P. J. N77-11407
ODONNELL, R. D. N77-11686
OFFIR, J. N77-11758
OGILVIE, K. W. N77-11944
OHLSSON, D. N77-11864
OHLSSON, E. N77-11919
OKSMAN, H. C. N77-11849
OLDENGARM, J. N77-11242
OLDHAM, G. A. N77-11479
OLEGOV, T. N77-11670
OLSON, J. J. N77-11887
ONISCHAK, M. N77-11677
ONO, K. N77-11163
N77-11460
OPRESCU, N. N77-11494
ORDIN, P. M. N77-11901
ORLOFF, K. L. N77-11390
ORRINGER, O. N77-11042
OSSAKOW, S. L. N77-11623
OSTDIEK, F. R. N77-11408
OTTENS, H. H. N77-11450
OWEN, F. K. N77-11247

P

PACKARD, D. J. N77-11287
PAGE, D. N. N77-11940
PALME, J. N77-11738
PAPAILIOU, D. N77-11354
PAPILIOU, K. N77-11009
PARDO, L. T. N77-11790
PARK, S. K. N77-11099
PARKER, J. A. N77-11111
PARKER, R. J. N77-11404
PARRA, G. T. N77-11364
PARRIS, D. C. N77-11150
PASHION, V. N77-11699
PASINI, S. N77-11245
PATCH, R. W. N77-11718
PATTON, J. M., JR. N77-11001
PAUL, G. R. N77-11178
PAULISH, D. J. N77-11252
PAULSON, B. C., JR. N77-11679
PAYNE, W. A. N77-11136
PAZICH, P. M. N77-11626
PEAKE, D. J. N77-10999
N77-11357
PEALAT, M. N77-11234
PEISER, H. S. N77-11214
N77-11216
PELIZZARI, M. A. N77-11934
PELOUCH, J. J., JR. N77-11901
PENNEY, T. R. N77-11015
PENNOTTI, R. J. N77-11263
PERKINS, J. N. N77-11412
PERKINS, P. J. N77-11612
PERL, J. N77-11757
PERRY, B. N. N77-11828
PERULLI, M. N77-11238
PETERS, W. A. N77-11511
PETERSEN, A. N77-11302
PETERSON, D. E. N77-11462
PETROV, G. I. N77-11951
PETTIT, F. S. N77-11160
PFEIFER, H. J. N77-11222
N77-11373
PHILLIPS, J. L. N77-11772
PHILPOT, W. N77-11486
PIERS, W. J. N77-11011
N77-11071
PIERSMA, H. J. D. N77-11080
PIGG, J. C., JR. N77-11964
PLAGER, S. J. N77-11583
PLATOU, A. S. N77-11016
PLOSKI, A. B., JR. N77-11275
POCKLINGTON, R. C. N77-11077
POETZLBERGER, H. N77-11306
POLLACK, I. N77-11685
POMALAYA, J. C. N77-11487
PONOMAREV, Y. A. N77-11616
POOL, A. N77-11020
POPELAS, J. N77-11699
POPOVICS, S. N77-11470

POPP, G. N77-11305
PORATH, Y. N77-11566
PORTER, J. H. N77-11015
POST, R. E. N77-11175
POTTER, J. M. N77-11478
POTTER, W. H. N77-11947
POWELL, A. L. N77-11142
POWELL, J. D. N77-11672
POWELL, R. W. N77-11087
PRATER, B. E. N77-11579
PRAVDO, S. H. N77-11935
PRIGENT, G. N77-11191
PRITSKER, A. A. B. N77-11689
PRIVAL, H. G. N77-11143
PROBINE, M. C. N77-11500
PROK, G. M. N77-11213
PROKHORENKO, V. I. N77-11093
PRUST, H. W., JR. N77-11007
PUGH, P. G. N77-11070
PUTNAM, D. F. N77-11671
N77-11676

R

RAAB, B. N77-11108
RADLINSKI, R. P. N77-11820
RAFFOUL, G. W. N77-11253
RAINBIRD, W. J. N77-11357
RAMACCI, C. A. N77-11651
RAMAKER, T. J. N77-11465
RAMBERG, S. E. N77-11353
RAMSEY, P. E. N77-11000
N77-11090
RAPPOLD, A. N77-11270
RAUFER, R. K. N77-11588
RAUSCHENBACH, H. S. N77-11531
RAWLIN, V. K. N77-11103
N77-11104
N77-11106
REA, R. L. N77-11931
READER, K. E. N77-11268
REAP, R. M. N77-11638
REDDY, N. N. N77-11045
REDIKER, R. N. N77-11856
REES, G. H. N77-11315
REID, I. A. N77-11501
REILLY, J. J. N77-11201
REISFELD, R. N77-11141
RENIERI, G. D. N77-11113
RENIERI, M. P. N77-11112
RESHOTKO, M. N77-11053
REYNIN, I. V. N77-11615
REYNOLDS, J. M. N77-11853
REYNOLDS, R. K. N77-11398
REYNOLDS, S. L. N77-11581
RICCITIELLO, S. R. N77-11119
RICE, E. J. N77-11817
RICE, R. F. N77-11717
RICHARDS, W. N77-11855
RIETHMULLER, M. L. N77-11229
RIVIR, R. B. N77-11408
ROBERTS, D. V. N77-11454
ROBERTSON, J. A. L. N77-11533
ROBERTSON, S. J. N77-11092
ROBINSON, D. A. N77-11538
ROBSON, R. R. N77-11100
ROCKAFELLAR, R. T. N77-11793
RODGERS, G. N77-11553
ROMANSKI, J. G. N77-11782
ROSA, C. J. N77-11161
ROSCHY, M. N77-11306
ROSCOE, S. N. N77-11687
ROSS, D. H. N77-11395
ROSSER, R. W. N77-11111
ROSSMANN, G. E. N77-11691
ROTHSCHILD, R. E. N77-11935
ROUCHALEAN, Y. N77-11774
ROWELL, L. F. N77-11087
ROYER, H. N77-11372
RUBIN, J. N77-11179
N77-11181
RUDE, L. C. N77-11468
RUDERMAN, H. N77-11909
RUGGERI, R. S. N77-11004
RUPP, C. C. N77-11079
RUSH, M. N77-11502
RUSSO, S. C. N77-11211
RZONCA, L. I. N77-11867

S

SACHS, M. B. N77-11656
SACHS, W. M. N77-11743
SALLES, Y. N77-11528
SALZANO, F. J. N77-11201
SANCIER, K. M. N77-11174
SANDBORN, V. A. N77-11343
SANDERS, T. G. N77-11593
SANDSTROM, D. R. N77-11382
SANTANA, C. E. N77-11850
SARGENT, N. B. N77-11051
SARKAR, T. K. N77-11254
SATHAYE, J. N77-11909
SAUER, R. L.
SAUSENG, O.
SAVA, P. G.
SAVASTANO, K.
SAWKO, P. M.
SAWYER, D. E.
SAXENA, A. R.
SCANNAPIECO, A. J.
SCERBO, L. J.
SCHACHER, E. E.
SCHARF, L. L.
SCHAUER, A. -
SCHEAFFER, R. L.
SCHEIDEL, F.
SCHETZ, J. A.
SCHILLING, D. L.
SCHIPHOLT, G. J.
SCHLESINGER, J. D.
SCHLIEKELMANN, R. J.
SCHMEISSER, F.
SCHMIDT, H. J.
SCHMIDT, J. F.
SCHNAKENBERG, G.
SCHNEIDER, P. M.
SCHOENSTADT, A. L.
SCHOENTHAL, M.
SCHOFF, C. K.
SCHOLER, C. F.
SCHOLL, F. W.
SCHOOL, R.
SCHREYER, G.
SCHRIDER, L. A.
SCHUETZ, D.
SCHULTZ, K. J.
SCHULZ, W.
SCHUSTER, G. M.
SCHWITZGEBEL, K.
SCRUGGS, R. M.
SCUDDER, J. D.
SEEGMILLER, H. L.
SEIDEL, K.
SEIFERT, D. J.
SEITH, W.
SEM-JACOBSEN, C. W.
SENGEISSEN, C.
SERGEYEV, G.
SERLEMITSOS, P. J.
SERPER, A.
SETTLES, G. S.
SHABAIK, A. H.
SHAFER, B. P.
SHAMROTH, S. J.
SHARP, D. G.
SHATAYEV, V. G.
SHAVER, J. R.
SHEA, J.
SHENTON, D. C.
SHEPHERD, L. W.
SHERMAN, C. C.
SHIBATA, M.
SHIFLET, A. B.
SHIMOJO, S.
SHIN, S. Y.
SHOJI, D.
SHOSTAK, R. E.
SHOWEN, R. L.
SHRIDER, K. R.
SHUMAN, M. S.
SHUMATE, M. S.
SHUNK, F. A.
SIDDIQUI, K. M.
SIDHU, G. S.
SIEBERT, E. T.
SIEGEL, A. I.
SIGAL, C. E.
SIGNORELLI, R. A.
SILL, B. L.
SIMON, C. E.
SIMON, F.
SIMS, D.
SISCOE, G. L.
SIVO, J. N.
SIZER, J. E.
SKELTON, R. E.
SKINNER, G. L.
SKOP, R. A.
SLOAN, J. C.
SLOOFF, J. W.
SMART, D. F.
SMIECINSKI, R. F.
SMIGIELSKI, P.
SMITH, B. W.
SMITH, I. E.
SMITH, J. A.
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SOEPAWIDJAJA, M.
SONTAG, E. D.
SORDAHL, L. A.
SPAGNOLO, F. A.
SPANGLER, S. B.
SPELLMAN, D. L.
SPENCER, J. A.
SPENCER, J. L.
SPITZEN, J. M.
SPRADLEY, L. W.
SPRAY, G. W.
SPRENGEL, H. P.
SRIKRISHNAN, V.
SRINIVASAN, S.
STALLINGS, R. L., JR.
STAMPFER, J. F., JR.
STASKUS, J. V.
STEELE, S. R.
STEENBERGEN, J.
STEIN, W. L.
STEINER, B. W.
STEINHEIL, E.
STEINHOFF, H. W.
STENGL, J. P.
STENSON, E. M. S.
STEPHENS, J. B.
STEPP, W.
STEVENSON, S. M.
STEVENSON, W. H.
STIEF, L. J.
STIMSON, M. J.
STIRLING, I. F.
STOKES, J. D.
STONE, C. H.
STONE, H. C.
STONE, H. L.
STONE, H. W.
STONE, J. R.
STRAND, L. D.
STRANGMAN, T. E.
STRAWBRIDGE, J. T.
STREENIVASAN, K.
STRICKLAND, G.
STRIKE, W. T.
STROMSWOLD, D. C.
STUART, R. C.
STUCKEY, D. C.
STUCKI, L. G.
SUGGATE, R. P.
SUGIMORI, Y.
SUH, S. K.
SUITS, K. W.
SUNG, C. H.
SUPERFESKY, M. J.
SUUBERG, E. M.
SVALGAARD, L.
SWANK, J. H.
SWIDERSKI, A. A.
SWIESKOWSKI, H. P.
SWITZER, D.
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T

TAHERI, E. H. Z. N77-11547
TAI, T. C. N77-11356
TAKEDA, K. N77-11488
TAN, W. Y. N77-11794
TARAN, J. P. N77-11234
TARGOFF, D. M. N77-11288
TAWIL, M. M. N77-11423
TAYLOR, D. F. N77-11680
TAYLOR, R. L. N77-11896
TEMKIN, A. N77-11830
TENNERY, V. J. N77-11534
TERRY, R. E. N77-11890
TESCHE, T. W. N77-11599
THEBERGE, N. B. N77-11598
THOMAS, C. O. N77-11200
THOMAS, C. R. N77-11125
THOMAS, D. G. N77-11860
THOMAS, G. N77-11157
THOMPSON, C. M. N77-11607
THOMPSON, D. J. N77-11965
THOMPSON, F. B. N77-11731
THOMPSON, J. N77-11699
THONG, T. N77-11255
THORGERSON, E. J. N77-11329
THORNGATE, J. H. N77-11823
THORNTON, J. B. N77-11469
THORPE, R. N77-11933
TIAO, G. C. N77-11773
N77-11794
TIBBETS, J. G. N77-11045
TIFFT, W. C. N77-11362
TODA, M. N77-11063
TODD, M. J. N77-11407
TOENSHOFF, D. A. N77-11062
TON-THAT, L. N77-11282
TORKILDSEN, R. A. N77-11380
TOTH, L. R. N77-11197
TREIBER, M. N77-11627

TREMAINE, S. D. N77-11943
TREU, S. N77-11747
TROUT, A. M. N77-11056
TSAI, S. S. N77-11338
TSOY, K. A. N77-11785
N77-11786
TSUCHIYA, K. N77-11488
TUNG, T. T. N77-11319
TUOMINEN, H. V. N77-11490
TURK, A. N77-11591
TURKEL, E. N77-11771
TYNES, W. O. N77-11455

U

UCAR, M. N77-11551
ULRICHSON, D. L. N77-11541
UPPULURI, V. R. R. N77-11765
USPENSKIY, G. P. N77-11075
UTREJA, L. R. N77-11003

V

VALENTINO, A. R. N77-11256
VANBUREN, A. L. N77-11742
VANDENBERG, B. N77-11011
VANDYKE, P. N77-11013
VANKAMPEN, C. L. N77-11655
VANPAPPELENDAM, C. A. N77-11036
VANRIPER, K. A. N77-11843
VANWOERKOM, P. T. L. M. N77-11097
VASSILAROS, M. G. N77-11413
VASSOUT, P. N77-11639
N77-11641
VASYLIUNAS, V. M. N77-11944
VAUDREY, K. D. N77-11461
VAUGHAN, R. W. N77-11397
VER, I. L. N77-11068
VERNON, S. N77-11502
VEZZETTI, C. F. N77-11367
VIDAL, R. J. N77-11352
VINANTE, C. D. N77-11760
VINSON, R. P. N77-11386
VIRAMONTES, F. A. N77-11525
VLADECK, B. C. N77-11926
VOGE, V. M. N77-11647
VOGEL, M. E. N77-11926
VOGT, G. J. N77-11203
VOLK, F. N77-11194
VOLLRATH, K. N77-11368
N77-11392
VOLTZ, S. E. N77-11202
VONBECKH, H. J. N77-11647
VONGLAHN, U. N77-11815
VORBURGER, T. V. N77-11382

W

WACLAWSKI, B. J. N77-11382
WAERE, O. N77-11918
WAGMAN, I. H. N77-11661
WAHL, A. C. N77-11831
WAKKER, K. F. N77-11080
WALKER, S. N. N77-11527
WALLACE, V. L. N77-11699
WALRAVEN, G. D. N77-11959
WALTERS, D. H. N77-11741
WALTOCH, R. N77-11566
WALTZ, R. E. N77-11866
WANG, R. T. H. N77-11835
WARE, T. C. N77-11048
N77-11049
WARREN, G. E. N77-11312
WARREN, W. H., JR. N77-11936
WAUGH, J. D. N77-11684
WEAVER, J. A. N77-11907
WEBBER, S. N77-11560
WEBER, C. R. N77-11271
WEBER, R. N77-11314
WEBER, R. R. N77-11947
WECKER, S. C. N77-11267
WEGMANN, F. J. N77-11932
WEIGAND, A. J. N77-11655
WEISGERBER, F. E. N77-11424
WEISSBERG, R. W. N77-11922
WELDON, J. L. N77-11905
WELLS, R. M. N77-11574
WELSCH, W. N77-11298
WEST, W. P. N77-11826
WESTINE, P. S. N77-11464
WESTON, J. P. N77-11219
WHALEN, J. J. N77-11316
WHEATON, W. A. N77-11963
WHITCRAFT, A. N77-11468
WHITE, D. M. N77-11257
WHITE, W. H. N77-11578
WHITEHEAD, R. E. N77-11220
WHITELAW, J. H. N77-11246
WHITESIDE, A. E. N77-11524
WHITTEN, G. Z. N77-11599
WHYTOCK, D. A. N77-11136
WIELEMAKER, A. N77-11121
WIENER, D. N77-11566
WILCOX, J. M. N77-11955
N77-11956
WILCOX, P. D. N77-11310
WILEN, B. O. N77-11484
WILLARD, W. E. N77-11058
WILLIAMS, A. R. N77-11420
WILLIAMS, J. B. N77-11258
WILLIAMS, L. G. N77-11683
WILLIS, R. N77-11921
WILSON, N. H. M. N77-11922
WILTSHIRE, L. L. N77-11022
WINGATE, F. B. N77-11696
WINTUCKY, E. G. N77-11102
WISE, J. J. N77-11202
WITTIG, M. N77-11350
WOFFINDEN, G. J. N77-11384
WOHAK, K. N77-11307
WOLF, J. J. N77-11420
WOLLMER, R. D. N77-11778
WONG, K. C. N77-11249
WONG, P. P. K. N77-11517
WOOD, H. A. N77-11478
WOODSTROM, J. H. N77-11457
WOODWARD, W. S. N77-11811
WOOLF, S. N77-11832
WORTHINGTON, T. K. N77-11210
WORTMAN, D. B. N77-11689
WRIGHT, I. G. N77-11162
WU, D. L. N77-11609
WU, J. H. H. N77-11433
WU, J. L. N77-11567
WU, L. H. N77-11434
WYATT, J. N77-11028

Y

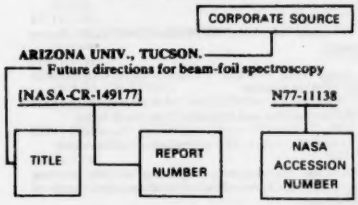
YAHALOM, J. N77-11168
YANG, J. Y. N77-11325
YANG, S. M. N77-11709
YANTA, W. J. N77-11223
YARZAB, R. F. N77-11535
YEE, S. Y. K. N77-11775
YEH, Y. S. N77-11541
YENNI, K. R. N77-11033
YIFTAH, S. N77-11565
YIN, R. K. N77-11926
YOCKE, M. A. N77-11599
YODER, D. N77-11897
N77-11898
N77-11899
YOUNG, K. K. D. N77-11688
YOUNG, L. G. N77-11632
YOUNG, L. R. N77-11030
YOUNG, L. Y. N77-11577
YOUNG, R. D. N77-11217

Z

ZABALUYEV, V. V. N77-11615
ZABEL, T. H. N77-11110
ZALAY, A. D. N77-11002
ZANIOLO, C. A. N77-11690
ZAREMBA, E. N77-11159
ZARETSKY, E. V. N77-11404
ZARLING, R. N77-11699
ZATSEPIN, G. T. N77-11946
ZEGER, A. E. N77-11278
ZILIOLI, E. N77-11493
ZWINGMAN, R. N77-11871
ZYSK, E. D. N77-11062

CORPORATE SOURCE INDEX

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The NASA accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ACADEMY OF SCIENTIFIC RESEARCH AND TECHNOLOGY, CAIRO [EGYPT].
Geological and environmental resources investigations in Egypt using LANDSAT images
[E77-10039] N77-11499

ADELAIDE UNIV. [AUSTRALIA].
On buckling of viscoelastic plates
N77-11443

ADELPHI UNIV., GARDEN CITY, N.Y.
The ground state electronic structure of atomic boron
N77-11827

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, PARIS [FRANCE].
On the flow quality necessary for the Large European High-Reynolds-Number Transonic Windtunnel LEHRT
[AGARD-R-644] N77-11070
Small solid propellant rockets for field use
[AGARD-CP-194] N77-11185
Specifications of the propulsion systems for antitank rockets
N77-11187
Applications of non-intrusive instrumentation in fluid flow research
[AGARD-CP-193] N77-11221
Fluid Dynamics Panel Symposium on Flow Separation
[AGARD-AR-98] N77-11357
The pathophysiology of high sustained +G sub z acceleration, limitation to air combat manoeuvering and the use of centrifuges in performance training
[AGARD-CP-189] N77-11644
OCR and its application to documentation: A state of the art review
[AGARD-AG-216] N77-11907

AEG-TELEFUNKEN, ULM [WEST GERMANY].
Rapid electrographic and electrophotographic processes. Lenard window for electrostatic printing tubes
[BMFT-FB-T-76-06] N77-11299
Technological studies of high mission current density cathodes
[BMFT-FB-T-76-10] N77-11301

AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO.
Project screening
[AD-A023837] N77-11894

AEROSPACE CORP., EL SEGUNDO, CALIF.
Comment on A paradox: The thermal rate coefficient for the H + DCl yields HCl + D exchange reaction
[AD-A023896] N77-11139
Experimental studies of a continuous-wave HF[DF] confocal unstable resonator
[AD-A025268] N77-11395
Electronic angular momentum transfer in the I[doublet P[1/2]] + NF [a singlet delta] system
[AD-A024258] N77-11833
A quasi-linear kinetic equation for cosmic rays in the interplanetary medium
[AD-A023849] N77-11966

AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.
Influence of aircraft angle of attack on high G cockpit design
[AD-A025083] N77-11043

AEROSPACE SYSTEMS, INC., BURLINGTON, MASS.
Display/control requirements for VTOL aircraft
[NASA-CR-145026] N77-11030

AIR FORCE ACADEMY, COLO.
The measurement of spatial vorticity distributions using hot-wire anemometry techniques
[AD-A024161] N77-11014
Validation of soil stabilization index system with manual development
[AD-A024549] N77-11456
A conceptual model for evaluating contractor management during source selection
[AD-A023817] N77-11896

AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
Development of electronic circuits for advanced high temperature fire detectors
[AD-A023843] N77-11318

AIR FORCE CAMBRIDGE RESEARCH LABS., L. G. HANSCOM FIELD, MASS.
An invariant imbedding, orders-of-scattering approach to particle transport in a slab
[AD-A024155] N77-11832

AIR FORCE FLIGHT DYNAMICS LAB., WRIGHT-PATTERSON AFB, OHIO.
Flight test demonstration of selected curved-segmented approach paths based on microwave landing system guidance
[AD-A025501] N77-11028
Current practice on estimating crack growth damage accumulation with specific application to structural safety durability and reliability
[AD-A025499] N77-11478

AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MASS.
Geomagnetic effects: A rapporteur paper
[AD-A023720] N77-11620
Conditional probabilities of the geomagnetic index A sub p
[AD-A023675] N77-11626
A shooting method for the solution of a discrete Poisson equation on the surface of a sphere
[AD-A024158] N77-11775
Star catalogues and their significance to geodesy of the 1980's
[AD-A024156] N77-11938

AIRESEARCH MFG. CO., PHOENIX, ARIZ.
Compressor blade setting angle accuracy study, volume 1
[NASA-CR-135068-VOL-1] N77-11046
Compressor blade setting angle accuracy study. Volume 2: Data compilation
[NASA-CR-135068-VOL-2] N77-11047
Small axial compressor technology, volume 1
[NASA-CR-134827-VOL-1] N77-11048
Small axial compressor technology, volume 2
[NASA-CR-134827-VOL-2] N77-11049
Study of small turbofan engines applicable to single-engine light airplanes
[NASA-CR-137944] N77-11054

ALABAMA UNIV., HUNTSVILLE.
Earth and ocean modeling
[NASA-CR-150055] N77-11617

AMES LAB., IOWA.
Thermochemical water splitting: The reverse Deacon reaction and alternatives
[IS-M-63] N77-11541

APPLETON LAB., SLOUGH [ENGLAND].
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 2: Scientific objectives and passive sounder instruments
[ESA-CR[P]-836-VOL-2] N77-11088
Phase A study of Spacelab-borne atmospheric passive experiments. Volume 3: Accommodation of instruments and packages on Spacelab
[ESA-CR[P]-836-VOL-3] N77-11089

APPLIED PHYSICS LAB., JOHNS HOPKINS UNIV., LAUREL, MD.
Viscous flow at the boundary of a porous material
[AD-A022715] N77-11351
Time series analysis applied to data from a single ocean wave gauge
[AD-A023821] N77-11769

APPLIED PSYCHOLOGICAL SERVICES, WAYNE, PA.
A model for predicting integrated man-machine system reliability. 2: Model validation
[AD-A023886] N77-11420

APPLIED SYSTEMS CORP., VIENNA, VA.
The production and refining of crude oil into military fuels
[AD-A024652] N77-11207

ARGONNE NATIONAL LAB., ILL.
MATCH package for the ANL three-view geometry program
[ANL/HEP/PR-76-11] N77-11719

ARIZONA STATE UNIV., TEMPE.
An algorithm for synthesis of combinational logic using decomposition and probability
N77-11706

ARIZONA UNIV., TUCSON.
Future directions for beam-foil spectroscopy
[NASA-CR-149177] N77-11138
Techniques for modeling multidimensional effects in integrated devices
N77-11292
Evaluation of a large format image tube camera for the shuttle sortie mission
[NASA-CR-149093] N77-11362
A basis for analyzing prospective power generation in terms of environmental management and energy use
N77-11526
Eight-year applied optics research report
[AD-A025340] N77-11857
The mass spectrum of charged cosmic rays at mountain altitudes
N77-11962

ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LAB., CLEVELAND, OHIO.
Hot hardness of nickel-rich nickel-chromium-aluminum alloys
[NASA-TM-X-3429] N77-11155

ARMY AVIATION ENGINEERING FLIGHT ACTIVITY, EDWARDS AFB, CALIF.
Army preliminary evaluation YOH-58A helicopter with a flat-plate canopy
[AD-A024501] N77-11039

ARMY AVIATION SYSTEMS COMMAND, ST. LOUIS, MO.
Bearing restoration by grinding
[NASA-CR-149188] N77-11404

ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY, FORT HUACHUCA, ARIZ.
Ground resistance for MF/HF design analysis of grounded antenna systems
[AD-A025090] N77-11281

ARMY CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, ILL.
Environmental impact computer system attribute descriptor package: Reference document
[AD-A024303] N77-11582

ARMY ELECTRONICS COMMAND, FORT MONMOUTH, N.J.
Dual band airborne antenna test program
[AD-A024024] N77-11275
Study of the use of Cefly Lancer wideband data link equipment for Guardrail 2A, 4, and 5.
[AD-A025089] N77-11280
A new ceramic flat pack for quartz resonators
[AD-A024074] N77-11310

ARMY ENGINEER DISTRICT, TULSA, OKLA.
Red River chloride remote sensing study
[NASA-CR-149189] N77-11503

ARMY ENGINEER TOPOGRAPHIC LABS., FORT BELVOIR, VA.
Inferential techniques for soil depth determinations. Part 1: Coleogyne ramosissima Torr. [Black-brush]
[AD-A024355] N77-11627

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS.
Comparison of 4-1/2- and 7-in. [6-in. nominal] maximum size aggregate mixtures for new lock and dam no. 26, Mississippi River
[AD-A023968] N77-11455
The use of remote sensing devices for acquiring data for environmental management purposes. Report 2: Application of photographic remote sensors to an environmental management problem
[AD-A025616] N77-11519
Tables for determining isotropic and anisotropic shear strengths from consolidated undrained triaxial compression tests
[AD-A024025] N77-11625
ARMY MATERIAL SYSTEMS ANALYSIS ACTIVITY, ABERDEEN PROVING GROUND, MD.
Necessary conditions for the existence of some incomplete block designs
[AD-A025856] N77-11779
ARMY MATERIALS AND MECHANICS RESEARCH CENTER, WATERTOWN, MASS.
Ceramic materials and components for small automotive gas turbine engine
[AD-A025472] N77-11417
ARMY NUCLEAR AGENCY, FORT BLISS, TEX.
The electromagnetic pulse [EMP]
[AD-A023775] N77-11277
ARMY WAR COLL., CARLISLE BARRACKS, PA.
Application of principles of organizational structure to high technology activities
[AD-A024012] N77-11895
An analysis of the technology role in US power during the mid-range period
[AD-A024042] N77-11927
ARNOLD ENGINEERING DEVELOPMENT CENTER, ARNOLD AIR FORCE STATION, TENN.
Application of the dual-scatter laser velocimeter in transonic flow research
N77-11225
ARO, INC., ARNOLD AIR FORCE STATION, TENN.
The AFFDL-Nielsen flow-field study
[AD-A023755] N77-11015
A wind tunnel captive aircraft testing technique
[AD-A023690] N77-11037
Heat-transfer tests on the Rockwell International space shuttle orbiter with boundary-layer trips [OH-54]
[AD-A024553] N77-11098
ASPHALT INST., COLLEGE PARK, MD.
Asphalt hot-mix emission study
[PB-250504/8] N77-11542
ATOMIC ENERGY COMMISSION, DACCA [BANGLADESH].
Investigations using data from LANDSAT-2
[E77-10029] N77-11492
ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, RISO [DENMARK].
The time-of-flight laser anemometer
N77-11243
ATOMIC ENERGY OF CANADA LTD., CHALK RIVER [ONTARIO].
Automated wavelength selection for flame spectroscopy
[AECL-5311] N77-11137
Susceptibility of cold-worked zirconium-2.5 wt. percent niobium alloy to delayed hydrogen cracking
[AECL-5260] N77-11156
TREND: A program using cumulative sum methods to detect long-term trends in data
[AECL-5262] N77-11723
ATOMIC ENERGY OF CANADA LTD., OTTAWA [ONTARIO].
Research and development for Canadian nuclear power
[AECL-5314] N77-11533
AUTOMOTIVE TESTING LABS., INC., AURORA, COLO.
An evaluation of high altitude engine modification devices [econo-kit]
[PB-255556/3] N77-11589

B

BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.
An improved projectile boattail, part 2
[AD-A024073] N77-11016
Some supersonic wind tunnel nozzle boundary layer characteristics
[AD-A024980] N77-11018
An interior ballistics model for a spinning rocket motor
N77-11193
BATTELLE COLUMBUS LABS., OHIO.
Directionally solidified in situ metal matrix composites, part 1
[AD-A024217] N77-11162
Implications of alloy structure with respect to mechanical properties
[AD-A023832] N77-11164
Computer-aided design and manufacturing for extrusion of aluminum, titanium, and steel structural parts [phase i]
[AD-A023946] N77-11171
BELL HELICOPTER CO., FORT WORTH, TEX.
Helicopter reliability growth evaluation
[AD-A025265] N77-11041
BENDIX RESEARCH LABS., SOUTHFIELD, MICH.
AS-11B-X automated stereomapper
[AD-A025428] N77-11524
BETTIS ATOMIC POWER LAB., WEST MIFFLIN, PA.
Three-dimensional finite element analysis of a large circular disc with circular penetrations
[WAPD-TM-1206] N77-11444
BOEING AEROSPACE CO., SEATTLE, WASH.
Preliminary design-lift/cruise fan research and technology airplane flight control system
[NASA-CR-137971] N77-11064
BOEING CO., WICHITA, KANS.
Power transfer units for aircraft hydraulic systems
[AD-A024446] N77-11058
User evaluation of ride technology research
[NASA-CR-2746] N77-11667
BOEING COMMERCIAL AIRPLANE CO., SEATTLE, WASH.
A computational system for aerodynamic design and analysis of supersonic aircraft. Part 2: User's manual
[NASA-CR-2716] N77-11005
BOLT, BERANEK, AND NEWMAN, INC., CAMBRIDGE, MASS.
Investigation of the effects of nonhomogeneous [or nonstationary] behavior on the spectra of atmospheric turbulence
[NASA-CR-2745] N77-11034
Acoustical evaluation of the NASA Langley V/STOL wind tunnel
[NASA-CR-145087] N77-11068
BOOKER T. WASHINGTON FOUNDATION/CABLE-COMMUNICATIONS RESOURCE CENTER, WASHINGTON, D. C.
A preliminary review of current practices and trends in rural telecommunications development and recommendations for future development
[PB-254366/8] N77-11274
BOOZ-ALLEN APPLIED RESEARCH, INC., BETHESDA, MD.
Statistical model of sonic boom structural damage
[AD-A028512/2] N77-11818
BOSTON UNIV., MASS.
The construction of storm-time corrections for ionospheric F-region parameters and their application to trans-ionospheric group-path delay
[AD-A024408] N77-11621
BRIGHAM YOUNG UNIV., PROVO, UTAH.
Determination and possible public health impact of transition metal sulfite aerosol species
[PB-255407/9] N77-11590
Thermodynamic study of metal ion-macrocyclic ligand interaction
N77-11890
BRITISH STEEL CORP., SHEFFIELD [ENGLAND].
The development of steel plate for offshore structures
[PB-254195/1] N77-11453
Air pollution monitoring at the Redcar site: Measurement of grit and dust [3d]
[PB-254199/3] N77-11579
An operating manual for computer storage, access and presentation of plant trial data
[PB-256058/9] N77-11737
BROOKHAVEN NATIONAL LAB., UPTON, N.Y.
Hydrogen for energy storage: A progress report of technical developments and possible applications
[BNL-20931] N77-11201
Attic concentrator type solar energy collector
[BNL-50493] N77-11539
BROWN, BOVERI & CIE AKTIENGESELLSCHAFT, LAMPERTHEIM [WEST GERMANY].
Development of new active semiconductor surface passivation technologies for high blocking voltage power devices
[BMFT-FB-T-76-15] N77-11304
Development of processes for simultaneous diffusion of several dopant junction or doping elements for power devices
[BMFT-FB-T-76-16] N77-11305
BROWN UNIV., PROVIDENCE, R. I.
A three-component laser-Doppler-velocimeter
N77-11248
BRUSH WELLMAN, INC., CLEVELAND, OHIO.
Production engineering measures to manufacture super fine finish beryllia
[AD-A024470] N77-11315
BUREAU OF MINES, ALBANY, OREG.
Steel from urban waste
[PB-255441/8] N77-11167
BUREAU OF MINES, PITTSBURGH, PA.
A spiral sequential sampler for air and liquids, preliminary results
[PB-255435/0] N77-11386
Applying computer-drawn maps of geologic data to analysis of mining problems
[PB-255497/0] N77-11518

C

CALIFORNIA INST. OF TECH., PASADENA.
Single scattering particle laser Doppler measurements of turbulence
N77-11230
Discrete modeling and analysis of switching regulators
N77-11287
Practical natural language processing. The REL system as prototype
[AD-A024313] N77-11731
A study of some two-dimensional field theory models
N77-11835
Pulse NMR in solids: Chemical shift, lead fluoride and thorium hydride
N77-11873
Accretion into and emission from black holes
N77-11940
Interstellar space: The astrochemist's laboratory
N77-11941
A limit on the inhomogeneity of the cosmic microwave background radiation at an angular scale of 1.25 arcmin
N77-11964
CALIFORNIA STATE DEPT. OF TRANSPORTATION, SACRAMENTO.
Follow-up study for the California resilience design method
[PB-255121/6] N77-11454
Concrete aggregate durability tests
[PB-255436/8] N77-11457
Accelerated test development for Portland cement concrete
[PB-255714/8] N77-11472
CALIFORNIA STATE UNIV., LOS ANGELES.
Program Evaluation and Review Technique [PERT]: A planning and control tool for occupational field studies
[AD-A024131] N77-11897
Guidelines for research planning and design in task analysis
[AD-A024132] N77-11898
Management auditing
[AD-A024133] N77-11899
CALIFORNIA UNIV., BERKELEY.
Multi-parametric mathematical programming problems
[AD-A025715] N77-11741
Mathematical statistics and probability: Stochastic processes
[AD-A024082] N77-11787
The choice of technology in transport system development
N77-11912
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Utilization and limitations of phase transformations and microstructures in alloy design for strength and toughness
[LBL-4175] N77-11157
Effect of oxygen-catalyzed nuclear spin conversion on the low temperature heat capacity of methane
[LBL-4149] N77-11203
Dynamic programming approach to estimating gaps in large economic data bases
[LBL-4271] N77-11909
CALIFORNIA UNIV., LA JOLLA.
KKR analysis of the Anderson-McMillan theory of electronic structure of liquid metals
[AD-A024386] N77-11887
CALIFORNIA UNIV., LIVERMORE. LAWRENCE LIVERMORE LAB.
Draft environmental assessment of application by ERDA for a special land use permit for use of public lands in Wyoming for in situ coal gasification experiments
[UCID-17011] N77-11572
STIL: A static tool implementation language
[UCID-17014] N77-11722
Piecewise polynomial functions
[UCID-17059] N77-11767
Hartree-Fock energy curves, for BrH[+][X[P2]I], KrH[+][X1 sigma [+]], and RbH[+][X 2 sigma [+]]
[UCRL-51738] N77-11831
CALIFORNIA UNIV., LOS ANGELES.
Optimal multiple-arc trajectories for an all-aspect air-to-air missile
N77-11082
Vibration of a flexible spacecraft with momentum exchange controllers
N77-11095
Vibration of a flexible spacecraft with momentum exchange controllers
[NASA-CR-150058] N77-11096
Preparation and properties of beta-alumina/glass composites
[PB-255549/8] N77-11130
Strain energy criterion of martensitic transformation
[AD-A023781] N77-11163
Synthesis of new superhard materials and their application to cutting tools
[AD-A024342] N77-11166

The design of filters to have linear passband phase and arbitrary stopband loss
N77-11288
Holographic flow visualization
[NASA-CR-149182] N77-11365
Acoustic emission testing for structural applications
[AD-A024064] N77-11460
Analysis and design of relational schemata for database systems
N77-11690
The use of dynamic assertions to improve software quality
N77-11710
Computational algorithms for coding bound exponents
N77-11715
Control by model error estimation
[NASA-CR-150059] N77-11755
Approximation and interpolation by inner functions
N77-11761
Stochastic multistage linear differential game with decision-time constraints
N77-11784
A study of resonating group theory and alpha-helium elastic scattering
N77-11839

CALIFORNIA UNIV., SAN DIEGO.
Polarization induced surface dipole moments
[AD-A024387] N77-11159
Studies in gravitation
N77-11610
The complexity of parallel algorithms
N77-11707
Observation of the galactic hard X-ray background from the OSO-7 satellite
N77-11963

CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
An application of Wiener aqalysis to human visual psychophysical response
N77-11669
Special cases of the quadratic assignment problem
[AD-A025605] N77-11740
Knowledge acquisition from structural descriptions
[AD-A025074] N77-11759
Critical cutsets of graphs and canonical facets of set packing polytopes
[AD-A023854] N77-11806

CENTRE DE RECHERCHES DU BOUCHET, VERT DE PETIT [FRANCE].
New propellants for tactical weapons: Silanes
N77-11190
Strong impact propellants of little specific attenuation for radioelectric waves
N77-11191

CENTRO DI STUDI E RICERCHE DI MEDICINA AERONAUTICA E SPAZIALE, ROME [ITALY].
Utilization of human centrifuge for training military pilots in the execution of protective straining maneuvers
N77-11651

CHRYSLER CORP., NEW ORLEANS, LA.
Aerodynamic characteristics of a 0.00563 scale 142-inch diameter solid rocket booster [MSFC model 449 and 480] with side mounted stings in the NASA/MSFC 14-inch trisonic wind tunnel [SA14FA]
[NASA-CR-147645] N77-11000
An investigation of the aerodynamic characteristics of a 0.00548 scale model [model no. 486] of the space shuttle 146-inch diameter solid rocket booster at angels of attack from 113 deg to 180 deg in the AEDC PWT 4-foot transonic wind tunnel [SA16F]
[NASA-CR-147648] N77-11090

CINCINNATI UNIV., OHIO.
Effect of microstructure on the fatigue crack growth of a powder metallurgy nickel-base superalloy
N77-11153
Basic mechanisms providing oxidation resistance in structural metals at high temperatures. Volume 2: The defect structure of nonstoiometric rutile [Ti O2] and nonstoichiometric rutile containing 1 to 10 mole percent Cb205
[AD-A024540] N77-11161
Development of high fracture toughness in maraging steels
[AD-A025096] N77-11172
Optimal productivity for solid waste collection: A systems approach
N77-11913

CITY COLL. OF THE CITY UNIV. OF NEW YORK.
Applications of satellite technology for regional organizations [Project ASTRO]
[NASA-CR-149184] N77-11267
Electrochemical analysis of sulfidic and amine odorants
[PB-255092/9] N77-11591

CLARK UNIV., WORCESTER, MASS.
Investigation of critical phenomena in nickel through perturbed angular correlation experiments
N77-11147

CLARKSON COLL. OF TECHNOLOGY, POTSDAM, N.Y.
Electrical transport properties of itinerant and localized electron magnetic systems
N77-11878

CLEAN WATER CONSULTANTS, EL DORADO, CALIF.
Technical guidelines for public water systems
[PB-255217/2] N77-11928

CLEMSON UNIV., S.C.
Tresca yield condition in elastic-plastic finite element analysis
N77-11424

COLLEGE FOR CIVIL ENGINEERING, BUCHAREST [ROMANIA].
Use of LANDSAT data for natural resources investigation in the lower basin of Danube and Danube Delta
[E77-10032] N77-11494

COLORADO STATE UNIV., FORT COLLINS.
Ecological impacts of snowpack augmentation in the San Juan Mountains of Colorado
[PB-255012/7] N77-11514
Covariance-invariant discrete-time systems
[AD-A024273] N77-11757

COLORADO UNIV., BOULDER.
Dynamics of the continuous settling of discrete-particle slurries
N77-11134
Theory of shock structure in a Maxwell gas based on the Chapman-Enskog development through Super-Super-Burnett order
N77-11324
The finite integral method applied to some problems of structural mechanics
N77-11423
Experimental and numerical studies of rate-dependent materials
N77-11429
Catalytic reduction of nitric oxide with carbon monoxide by rare earth oxides and noble metal catalysts
N77-11567
Major gene analysis: An alternative approach to the study of the genetics of human behavior
N77-11665
Torsion and the geometry of spin
N77-11808
Brownian motion of interacting particles
N77-11824
Pion-nucleus scattering and the investigation of nuclear spin dependent effects
N77-11836
Studies of thick target fast neutron production and proton activation of the stable isotope tracer Ca-48 as applications of nuclear physics in medicine
N77-11837
Nonlinear ion motion in the slow ion cyclotron
N77-11840
Radiation and coupling properties of straight and curved optical waveguides
N77-11851
Transport processes within a plasma driven by a high-frequency electric field
N77-11859
Pump wavenumber dependent effects in the parametric instabilities of a plasma
N77-11863
Nonrelativistic electron stream propagation in the solar atmosphere and solar wind: Type 3 bursts
N77-11952
Radiative transfer and gas dynamics in galactic X-ray sources
N77-11957

COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE [U. S. HOUSE].
Noise Control Act extension
[GPO-52-021] N77-11910

COMMITTEE ON SCIENCE AND TECHNOLOGY [U. S. HOUSE].
Crew training and support activities
[GPO-75-984] N77-11678

COMPUTER GENETICS CORP., WAKEFIELD, MASS.
Development of a Raman system as a combustion diagnostic tool
[AD-A023935] N77-11140

CORNELL UNIV., ITHACA, N.Y.
Advanced concepts of microwave generation and control in solids
[AD-A023950] N77-11311
User's guide to petroleum industry survey data type
[PB-256635/4] N77-11544
Nonlinear optical properties and crystal growth of II-IV-V2 chalcopyrite semiconductors
N77-11870
Optimal management of the subsurface environment: Parameter identification
[PB-255648/8] N77-11921
Observations of Jupiter with a Hadamard transform spectrometer
[AD-A025273] N77-11939

CORPS OF ENGINEERS, WALTHAM, MASS.
The LANDSAT satellite and flood control in New England, June 1976
[E77-10026] N77-11489

CRAMER [H.E.] CO., INC., SALT LAKE CITY, UTAH.
West Virginia power plant evaluation
[PB-255460/8] N77-11592

CRANFIELD INST. OF TECHNOLOGY [ENGLAND].
The measurement of igniter heat flux in solid propellant rocket motors
N77-11192

D

DARCOM INTERN TRAINING CENTER, TEXARKANA, TEX.
Feasibility study of performing system calibration in an operate mode
[AD-A024744] N77-11026

DBA SYSTEMS, INC., MELBOURNE, FLA.
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[AD-A024203] N77-11628

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[AD-A024600] N77-11902

DELAWARE UNIV., NEWARK.
Spectral reflectance signatures of coastal pollutants
[E77-10011] N77-11486

DENVER RESEARCH INST., COLO.
An inverse method for determining small variations in propagation speed
[AD-A025296] N77-11467
Inverse source problem: Eigenfunction analysis of Bojarski's integral equation
[AD-A025297] N77-11776

DENVER UNIV., COLO.
Nonlinear periodic response of a slender beam-column
N77-11435

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, CHRISTCHURCH [NEW ZEALAND].
Development of remote sensing technology in New Zealand, part 1. Seismotectonic, structural, volcanologic and geomorphic study of New Zealand, part 2. Indigenous forest assessment, part 3. Mapping land use and environmental studies in New Zealand, Part 4. New Zealand forest service LANDSAT projects, part 5. Geographical applications in LANDSAT mapping: Landuse mapping and environmental studies, part 6
[E77-10040] N77-11500

DEPARTMENT OF THE ENVIRONMENT, OTTAWA [ONTARIO].
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[E77-10041] N77-11501

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[AD-A023763] N77-11208

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK [WEST GERMANY].
Description of the model subsonic wind tunnel [MUK] for the large subsonic tunnel [GUK]. Construction, start-up, operation, first results
[DLR-IB-151-75/14] N77-11073
Flow direction measurements in the tandem test sections of the model subsonic wind tunnel [MUK]
[DLR-IB-151-76/1] N77-11074

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN [WEST GERMANY].
Visibility investigations for the Symphonie A and B satellites
[DLR-IB-552-74/5] N77-11094

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT E.V., LINDER HOEHE [WEST GERMANY].
The laser-dual-focus flow velocimeter
N77-11241

DOUGLAS AIRCRAFT CO., INC., LONG BEACH, CALIF.
Development of a graphite horizontal stabilizer
[AD-A023767] N77-11036

DREXEL UNIV., PHILADELPHIA, PA.
Prevention of defects in powder preform forging
N77-11148
Disturbance rejection and two classes of multivariable PI controllers with application to turbine-generator control
N77-11396

DYNAMIT NOBEL A.G., COLOGNE [WEST GERMANY].
Development of a small solid propellant rocket motor for flexible range requirements
N77-11188

E

EDINBURGH UNIV. [SCOTLAND].
Measurement of periodic flows using laser Doppler correlation techniques
N77-11232

EEG RESEARCH INST., OSLO [NORWAY].
Stress response and stress tolerance in fighter pilots during 6 G manoeuvers
N77-11653
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, LARAMIE, WYO.
Environmental impact studies related to underground coal gasification
[TID-27003] N77-11573
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, OAK RIDGE, TENN.
ERDA energy information data base: Magnetic tape description
[TID-4581-R3] N77-11695
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, WASHINGTON, D.C.
National program for solar heating and cooling [residential and commercial applications]
[ERDA-23A] N77-11540
ENERGY RESEARCH CORP., DANBURY, CONN.
Development of a prototype regenerable carbon dioxide absorber
[NASA-CR-137919] N77-11677
ENGELHARD MINERALS AND CHEMICALS CORP., EDISON, N.J.
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[AD-A025500] N77-11062
ENVIRO-MANAGEMENT AND RESEARCH, INC., WASHINGTON, D. C.
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[PB-254683/6] N77-11554
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[PB-255107/5] N77-11584
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[PB-256464/9] N77-11604
ENVIRONMENTAL TECHNOLOGY ASSESSMENT, INC., OAK BROOK, ILL.
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[PB-255699/1] N77-11588
EQUITABLE ENVIRONMENTAL HEALTH, INC., WOODBURY, N.Y.
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[PB-255697/5] N77-11563
ERNST AND ERNST, WASHINGTON, D.C.
Energy-economy relationships
[PB-255171/1] N77-11552
EXXON RESEARCH AND ENGINEERING CO., LINDEN, N.J.
Investigation and assessment of light-duty-vehicle evaporative emission sources and control
[PB-255813/8] N77-11603

F

FAIRCHILD SPACE AND ELECTRONICS CO., GERMANTOWN, MD.
Nuclear-powered Hysat spacecraft: Comparative design study
[ERDA-SNS-3063-8] N77-11108
FEDERAL COMMUNICATIONS COMMISSION, WASHINGTON, D.C.
Interference problems associated with proposed expansion of the 27 MHz citizens radio service band. Part 1: Summary
[PB-254488/0] N77-11271
Motor vehicle ignition radiation with respect to the SAE standard J551C
[PB-254187/8] N77-11273
FEDERAL ENERGY ADMINISTRATION, WASHINGTON, D.C.
Mandatory Canadian crude oil allocation regulations
[PB-255319/6] N77-11509
Strategic petroleum reserve
[PB-255476/4] N77-11546
Energy information activities at the FEA
[PB-253962/5] N77-11553
FEDERAL HIGHWAY ADMINISTRATION, WASHINGTON, D.C.
Follow-up study for the California resilience design method
[PB-255121/6] N77-11454
Improvement of Utah's flexible pavement performance system
[PB-254819/6] N77-11462
Highway insulating material evaluation
[PB-254792/5] N77-11466
Rigid pavement joints and sealants study
[PB-254806/3] N77-11469
Thermal activity of base course material related to pavement cracking
[PB-254754/5] N77-11476
The influences of retarding admixtures on volume changes of concrete
[PB-254929/3] N77-11477
FLORIDA UNIV., GAINESVILLE.
Procedure for maintenance and rework process quality control based on random sampling
[AD-A024257] N77-11421
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[AD-A024256] N77-11422
On discrete-time polynomial systems
[AD-A024481] N77-11774
Efficient solutions in multiobjective tree network location problems
[AD-A025289] N77-11777
Investigation of electronic transport, recombination and optical properties in In As sub 1-x P sub x alloy systems
[AD-A025294] N77-11889
FOREST PRODUCTS LAB., MADISON, WIS.
Hardboard-webbed I-beams subjected to short-term loading
[AD-A024507] N77-11465
FRAMAN DISTRIBUTORS LTD., WATFORD [ENGLAND].
An analysis of data taken from the impact viscometer at Imperial College
[AD-A023143] N77-11178
FRANKFORD ARSENAL, PHILADELPHIA, PA.
Reduction of target detectability by laser protective materials
[AD-A024383] N77-11682

G

GCA CORP., BEDFORD, MASS.
Design, development, fabrication and testing of a portable self-contained respirable dust mass monitor
[PB-254503/6] N77-11681
GENERAL ELECTRIC CO., PHILADELPHIA, PA.
Advanced hardened antenna window materials study 4
[AD-A023944] N77-11128
GENERAL ELECTRIC CO., WILMINGTON, MASS.
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[PB-254823/8] N77-11380
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[NASA-CR-150957] N77-11532
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[PB-255455/8] N77-11512
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A theory of ion sputtering
N77-11143
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N77-11233
Simulation of automatic detection and track-while-scan systems for unstabilized shipboard radars
N77-11257
On approximating and bounding GI/M/c queues
[AD-A023975] N77-11798
GEORGIA DEPT. OF TRANSPORTATION, FOREST PARK.
Rigid pavement joints and sealants study
[PB-254806/3] N77-11469
GEORGIA INST. OF TECH., ATLANTA.
Chemically reacting flows in porous media
N77-11327
Maxwell yields Boltzmann t yields infinity
N77-11331
On the elastic stability of shells
[NASA-CR-145088] N77-11440
Large-scale programming in Markov decision processes
N77-11712
Iterative forward-adjoint Monte Carlo solutions of the Boltzmann transport equation
N77-11783
Mathematical models of acoustic and acoustic-gravity wave propagation in fluids with height-dependent sound velocities
N77-11813
GILLETTE RESEARCH INST., INC., ROCKVILLE, MD.
Technology for using sulfate waste in highway construction
[PB-254815/4] N77-11468
GOODYEAR AEROSPACE CORP., AKRON, OHIO.
Design and development of a 28 foot tank, elastomeric coated fabric, collapsible, petroleum from a woven tube cloth
[AD-A025595] N77-11182
GREENFIELD, ATTAWAY AND TYLER, INC., SAN RAFAEL, CALIF.
Determination and possible public health impact of transition metal sulfite aerosol species
[PB-255407/9] N77-11590
GRUMMAN AEROSPACE CORP., BETHPAGE, N.Y.
Development of mathematical model for pneumatic tire-soil interaction in layered soils
[AD-A024162] N77-11416
Experimental evaluation of an options selection matrix as an operational decision aid
[AD-A023889] N77-11893

H

HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH.
Grain boundary structures and energies in fcc-iron
[HEDL-SA-1002] N77-11884
HARRY DIAMOND LABS., ADELPHI, MD.
CALFLO: A basic language program used in the calibration of Vol-O-Flow meters
[AD-A025466] N77-11388
Critical equipment list information retrieval
[AD-A025070] N77-11701
HARVARD UNIV., CAMBRIDGE, MASS.
Research on automatic programming
[AD-A024335] N77-11728
HAWAII INST. OF GEOPHYSICS, HONOLULU.
Computer program projecting fictitious longitude and latitude systems onto standard Mercator grids
[AD-A025076] N77-11517
HEALTH EFFECTS RESEARCH LAB., RESEARCH TRIANGLE PARK, N. C.
Regression using hockey stick functions
[PB-253576/3] N77-11576
HEBREW UNIV., JERUSALEM [ISRAEL].
Energy transfer between inorganic ions in glasses
[AD-A023910] N77-11141
HELSINKI UNIV. [FINLAND].
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[E77-10027] N77-11490
HERCULES, INC., WILMINGTON, DEL.
Analytical prediction of motor component vibrations driven by acoustic combustion instability
[AD-A025261] N77-11109
HONEYWELL, INC., MINNEAPOLIS, MINN.
Dynamic contrast requirements
[AD-A023973] N77-11683
HOUSTON UNIV., TEX.
Steady-state multiplicity of catalytic reaction systems
N77-11132
Remote sensing of temperature and composition of gas plumes by infrared emission interferometry-spectroscopy
N77-11135
The infinitely long Yagi array of concentric circular loops
N77-11253
Mathematical modelling for an unsteady vertically stratified flow field
N77-11335
HUGHES AIRCRAFT CO., CULVER CITY, CALIF.
Study of a Vuilleumier cycle cryogenic refrigerator for detector cooling on the limb scanning infrared radiometer
[NASA-CR-145078] N77-11211
HUGHES AIRCRAFT CO., FULLERTON, CALIF.
Photolithographic techniques for Surface Acoustic Wave [SAW] devices
[AD-A025492] N77-11822
HUGHES AIRCRAFT CO., TORRANCE, CALIF.
Intermodulation study
[AD-A023906] N77-11308
HUMAN ENGINEERING LABS., ABERDEEN PROVING GROUND, MD.
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[AD-A023728] N77-11684
HYDRONAUTICS, INC., LAUREL, MD.
High speed computer studies of vortex motions in relation to aircraft wake turbulence
[AD-A024290] N77-11013

I

IIT RESEARCH INST., CHICAGO, ILL.
Lamination residual stresses in hybrid composites, part 1
[NASA-CR-135085] N77-11114
Wave propagation in fiber composite laminates, part 2
[NASA-CR-135086] N77-11115
Strain rate effects on mechanical properties of fiber composites, part 3
[NASA-CR-135087] N77-11116
The effects of moisture on the mechanical performance of T300/graphite/glass/epoxy hybrid composites
[AD-A023668] N77-11124
Mechanical properties of glass and Kevlar molded composites
[AD-A024196] N77-11126

ILLINOIS INST. FOR ENVIRONMENTAL QUALITY, CHICAGO.
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[PB-255686/8] N77-11583

ILLINOIS INST. OF TECH., CHICAGO.
Embrittlement of carbon steels and iron by indium
N77-11149
Electric field in the focal region of an offset parabolic receiving antenna
N77-11256
Fast sequential decoding and a new complete decoding algorithm
N77-11705

ILLINOIS STATE DEPT. OF TRANSPORTATION, SPRINGFIELD.
Highway insulating material evaluation
[PB-254792/5] N77-11466

ILLINOIS UNIV., URBANA.
Bond characteristics of model reinforcement
[PB-255847/6] N77-11473
Enhancement of human effectiveness in system design, training, and operation: July 1974 - June 1975
[AD-A023941] N77-11687
Control and trajectory optimization of a robot arm
[AD-A023669] N77-11688

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A study of the 6180 angstrom diffuse interstellar band
N77-11942

INDIANAPOLIS CENTER FOR ADVANCED RESEARCH, IND.
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[AD-A023888] N77-11408

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A FORTRAN program for the computation of two-dimensional or axisymmetric nozzles
[ISL-R-110/75] N77-11012
Impulsive noise measurement methods and physiological effects
N77-11196
Behavior of various condensated explosives to shock waves calibrated in intensity and duration
[ISL-CO-211/75] N77-11204
Lagrange coordinate interior ballistic calculation model
[ISL-CO-215/75] N77-11205
Review on high speed applications of laser anemometry in France and Germany
N77-11222
Recent applications of ISL of the laser velocimeter measurements in turbulent flows
N77-11228
Local measurement and proportional density of gaseous flow by Raman anti-Stokes coherent scattering
N77-11235
New applications of laser anemometry to turbulent flow
[ISL-CO-212/75] N77-11349
Interferometry of transient phenomena using lasers emitting at different wavelengths in the UV, visible, and infrared spectral range
[ISL-36/74] N77-11368
Some properties of sources used in hypervelocity holography
[ISL-CO-217/75] N77-11369
Laser anemometry and displacement of the measurement point in industrial wind tunnels
[ISL-R-116/75] N77-11370
Comparison of instantaneous velocity measurements by hot-wire anemometry and laser anemometry
[ISL-R-117/75] N77-11371
Polychromatic light holography
[ISL-R-124/75] N77-11372
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[ISL-R-127/75] N77-11373
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[ISL-R-129/75] N77-11374
Application of hypervelocity backward reference holography to the study of dynamic deformations
[ISL-R-135/75] N77-11375
Density measurement of copper shaped charge jet using the flash radiography
[ISL-R-101/76] N77-11376
Optical and laser-interferometric investigations of an electron-beam-controlled CO2-laser
[ISL-35/74] N77-11392
Behavior of steel fragments on thin Duralumin targets. Oblique incidence. Multiple targets
[ISL-R-112/75] N77-11406
Influence of the peak pressure and duration of impulse noise [gun fire] on the hearing of the guinea pig
[ISL-R-109/75] N77-11639
Influence of a precursor noise on the global action potential consecutive to an impulse noise in the Guinea pig
[ISL-R-115/75] N77-11640
Study of metabolic response variation to an acoustic aggression
[ISL-R-120/75] N77-11641
Study of acoustic wave propagation in the atmosphere. Feasibility of an experimental study in the ISL sonic boom generator
[ISL-4/74] N77-11819

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High energy composite double base solid propellants
N77-11189
Determining the shelflife of solid propellants
N77-11194

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Methanol from coal fuel and other applications
[ORAU-126] N77-11200

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S2 probability and CNV [Contingent Negative Variation]
[IZF-1975-11] N77-11668

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[E77-10024] N77-11487

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[E77-10034] N77-11495

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Helicopter yaw axis augmentation investigation
[AD-A024512] N77-11066

ISRAEL ATOMIC ENERGY COMMISSION, YAVNEH.
The contribution of nuclear technology toward the solution of energy problems
[INIS-MF-1867] N77-11565

ISRAEL ELECTRIC CORP. LTD., HAIFA.
The nuclear power plant: Preview of its implications regarding the electricity grid
[INIS-MF-1868] N77-11566

J

JET PROPULSION LAB., CALIF. INST. OF TECH., PASADENA.
Propellant material compatibility program and results
[NASA-CR-149149] N77-11197
Reduction of gaseous pollutant emissions from gas turbine combustors using hydrogen-enriched jet fuel
[NASA-CR-149146] N77-11198
Nitramine propellant research
[NASA-CR-149148] N77-11199
Thin conformal antenna array for microwave power conversion
[NASA-CASE-NPO-13886-1] N77-11269
Structure of two-dimensional turbulent wall-jets in the presence of adverse pressure gradients
[NASA-CR-149126] N77-11354
Differential optoacoustic absorption detector
[NASA-CASE-NPO-13759-1] N77-11363
Hydrogen-fueled engine
[NASA-CASE-NPO-13763-1] N77-11398
RM2: rms error comparisons
[NASA-CR-149150] N77-11717
Integration-free interval doubling for Riccati equation solutions
[NASA-CR-149145] N77-11763

JOHNS HOPKINS UNIV., BALTIMORE, MD.
Predictive model of the auditory process as related to communication systems
[AD-A024300] N77-11656
Iterated codes with improved performance
N77-11704
A demonstration of the feasibility of using English as a programming language
N77-11708
The application of doubly stochastic Poisson process estimation techniques to optical communication through log-normal fading channels
N77-11782
Linear polarization measurements on gamma rays from Pd-100, Pd-102, Pd-104 and Pd-106
N77-11958

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Space is for man
[NASA-TT-F-16254] N77-11075
Space launches and finishes
[NASA-TT-F-17278] N77-11076
Nuclear reactions on the sun
[NASA-TT-F-17267] N77-11954

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[NASA-CR-149192] N77-11914

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Bosch technical instruction. Gasoline injection D and L-jetronic
[NASA-TT-F-17111] N77-11399

KENT UNIV., CANTERBURY [ENGLAND].
Supersonic velocity and turbulence measurements using a Fabry-Perot interferometer
N77-11227

KENTUCKY UNIV., LEXINGTON.
A note on distribution-free tolerance limits
[AD-A024137] N77-11788
Augmenting Lehman alternatives
[AD-A023789] N77-11789

KRUPP [FRIED.] G.M.B.H., ESSEN [WEST GERMANY].
Development of high pressure devices and high pressure syntheses
[BMFT-FB-76-19] N77-11177

L

LABORATORIUM FUER BETRIEBSFESTIGKEIT, DARMSTADT [WEST GERMANY].
Application of design data derived from fatigue tests with service-like load sequences for life prediction
[LBF-FB-109/76] N77-11445
Significance of measured local strains for the fatigue strength of joints
[LBF-FB-128/76] N77-11446
Compilation of measures to increase the fatigue strength of aircraft structures
[LBF-TB-126/75] N77-11447

LEHIGH UNIV., BETHLEHEM, PA.
Study of variables affecting lamellar tearing susceptibility of steels
N77-11152
Properties of Cr-SiO2-n Si tunnel diodes
N77-11291
A study of internal forced convective boiling heat transfer for binary mixtures
N77-11332
Effect of polymer state on the mechanical and transport behavior of polymer impregnated mortars
N77-11425
Computer control of distillation column containing analog overrides
N77-11703
On estimation of regression coefficients
N77-11760
A photocurrent spectroscopic method for determination of trapping state distributions in silicon dioxide thin films
N77-11875
One-electron energy bands of silicon dioxide in the ideal beta cristobalite structure
N77-11882

LEWIN AND ASSOCIATES, INC., WASHINGTON, D.C.
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[PB-255320/4] N77-11515

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[BMFT-FB-T-76-07] N77-11350

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[NASA-CR-137930] N77-11672

LINCOLN LAB., MASS. INST. OF TECH., LEXINGTON.
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[AD-A023818] N77-11314
Optics research
[AD-A025338] N77-11856

LINGUISTIC SYSTEMS, INC., CAMBRIDGE, MASS.
Occurence of gas hydrates in the nucleii of comets
[NASA-TT-F-16740] N77-11937
LITTLE [ARTHUR D.], INC., CAMBRIDGE, MASS.
Study of the feasibility of federal procurement of fuels produced from solid wastes
[PB-255695/9] N77-11513
LOCKHEED ELECTRONICS CO., HOUSTON, TEX.
Detailed design specification for the ALT Shuttle Information Extraction Subsystem [SIES]
[NASA-CR-151097] N77-11091
The ten-ecosystem study investigation plan
[NASA-CR-151099] N77-11505
LOCKHEED-GEORGIA CO., MARIETTA.
Vortex/jet/wing viscous interaction theory and analysis
[AD-A025290] N77-11017
Program for establishing long-time flight service performance of composite materials in the center wing structure of C-130 aircraft. Phase 4: Ground/flight acceptance tests
[NASA-CR-145043] N77-11032
V/STOL aircraft noise prediction [jet propulsors]
[AD-A028765/6] N77-11045
LOCKHEED MISSILES AND SPACE CO., HUNTSVILLE, ALA.
Development of predictive wake vortex transport model for terminal area wake vortex avoidance
[AD-A029049/4] N77-11002
Space shuttle contamination due to backflow from control motor exhaust
[NASA-CR-150054] N77-11092
Experimental and analytical study of thermal acoustic oscillations
[NASA-CR-150051] N77-11212
LOS ALAMOS SCIENTIFIC LAB., N.MEX.
Developmental system for microcomputer based intelligent graphics terminals
[LA-UR-76-125] N77-11694
LOWELL UNIV., MASS.
Far-infrared recombination radiation from impact-ionized shallow donors in n-type GaAs in high magnetic fields
N77-11880

M

MAGNAVOX-GENERAL ATRONICS, PHILADELPHIA, PA.
Adaptive Same Frequency Repeater [SFR] study
[AD-A023928] N77-11278
MARCONI SPACE AND DEFENCE SYSTEMS LTD., CAMBERLEY [ENGLAND].
Lubrication of bearings in vacuum. Examination of life-tested bearings from MSDS Ltd
[T[F]S/128] N77-11407
MARQUETTE UNIV., MILWAUKEE, WIS.
Performance of microwave diodes as detectors and mixers with respect to their device parameters
N77-11261
An experimental and analytical study of the sputtering phenomena
N77-11336
MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Analog computation assessment of the risk of structural failure due to crack growth under random loading
[AD-A025266] N77-11042
Qualitative and quantitative flow field visualization utilizing laser-induced fluorescence
N77-11237
Examples of pressure coefficients measured on a tall building
[PB-252416/3] N77-11452
Basic studies of coal pyrolysis and hydrogasification
[PB-254878/2] N77-11511
Some data-base applications of constraint expressions
[AD-A024149] N77-11727
Analysis of a simple factorization algorithm
[AD-A024416] N77-11790
Electron impact ionization cross sections of gold, chromium and iron
[AD-A024208] N77-11834
Experiments in texture perception
[AD-A024975] N77-11855
Molecular clusters and catalytic activity
[AD-A024349] N77-11888
Advanced dial-a-ride algorithms research project
[PB-254752/9] N77-11922
MASSACHUSETTS UNIV., AMHERST.
Rayleigh linewidth measurements in liquid helium
N77-11209
Radio-frequency wave coupling and mode conversion at the lower hybrid resonance
N77-11249
Low Reynolds number entrance flows: A study of a motionless mixer
N77-11319
Sources of organic color in natural waters
N77-11484
Designing a river basin sampling system
[PB-255022/6] N77-11593
The stabilization of bilinear systems and its application to the discrete model reference adaptive control
N77-11754
Compact transitive isometry groups
N77-11802
Characterization theorem for topological semilattices on the two-cell
N77-11803
Measurement and prediction of sound attenuation by highway barriers using acoustic modeling techniques
N77-11812
Measurement and prediction of sound attenuation by buildings using acoustic modeling techniques
N77-11814
Plane shock waves in quantum gases at very low temperatures
N77-11867
MATHEMATICA, INC., PRINCETON, N.J.
Analysis of unified testing theory
[AD-A023872] N77-11791
MATHEMATICAL SCIENCES NORTHWEST, INC., BELLEVUE, WASH.
Efficient high-energy HCl chemical laser
[AD-A023787] N77-11393
MATHEMATICS AND COMPUTATION LAB., WASHINGTON, D. C.
Utility programs for the UNIVAC 9300 system at the MCL computer facility
[PB-255891/4] N77-11739
MAX-PLANCK-INSTITUT FUER STROEMUNGSFORSCHUNG, GOETTINGEN [WEST GERMANY].
The Knudsen flow between oblique plates
[REPT-1/1976] N77-11347
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Ground test of the D shaped vented thrust vectoring nozzle
[NASA-CR-137959] N77-11107
Feasibility investigation of the Giromill for generation of electrical power
[COO-2617-75/1] N77-11536
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[NASA-CR-151007] N77-11077
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[NASA-CR-151102] N77-11084
Space station systems analysis study. Part 1, volume 2: Technical report
[NASA-CR-151103] N77-11085
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[NASA-CR-151104] N77-11083
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[NASA-CR-151094] N77-11078
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[MBL-1975-7] N77-11724
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[AD-A023908] N77-11622
METEOROLOGY RESEARCH, INC., ALTADENA, CALIF.
Optical method for measuring the mass concentration of particulate emissions
[PB-255093/7] N77-11384
Analysis of the data from the three-dimensional gradient study
[PB-253936/9] N77-11578
MICHIGAN STATE UNIV., EAST LANSING.
Gravity geophysics for groundwater exploration in glaciated areas
[PB-254542/4] N77-11510
MICHIGAN UNIV., ANN ARBOR.
Target detection in rapidly-changing visual sequences
[AD-A023784] N77-11685
Data structures: Specification and realization
[AD-A024396] N77-11698
A Bayesian approach to two-stage sampling
[AD-A025624] N77-11796
A class of network decomposition switches
[AD-A024325] N77-11797
MIDDLE ATLANTIC GOVERNORS' COASTAL RESOURCES COUNCIL.
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[PB-254925/1] N77-11516
MILAN UNIV. [ITALY].
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[E77-10030] N77-11493
MINISTRY OF PUBLIC WORKS, MEXICO CITY.
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[E77-10037] N77-11498
MINNESOTA ENERGY AGENCY, ST. PAUL.
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[PB-255321/2] N77-11555
MINNESOTA STATE PLANNING AGENCY, ST. PAUL.
ERTS-B applications to Minnesota resource management
[E77-10005] N77-11485
MISSOURI UNIV., COLUMBIA.
A new technique for measuring Doppler effect
N77-11360
Estimating probability of multiple occurrence of annual daily maximum rainfall
N77-11634
The development of chronic insertable oxygen electrodes
[AD-A024633] N77-11657
Some iterative procedures to obtain nonlinear least squares estimates
[AD-A024437] N77-11768
MISSOURI UNIV., ROLLA.
Preliminary aerosol generator design studies
[NASA-CR-150050] N77-11081
MITRE CORP., BEDFORD, MASS.
Evaluation of satellites and remote sensors for atmospheric pollution measurements
[NASA-CR-144970] N77-11569
Queuing analysis of an IBM 370 computer system
[AD-A025270] N77-11751
MITSUBISHI ELECTRIC MFG. CO. LTD., AMAGASAKI [JAPAN].
Local temperatures in semigray nondiffuse cones and V-grooves
N77-11341
MOBIL RESEARCH AND DEVELOPMENT CORP., PAULSBORO, N.J.
Development studies on conversion of methanol and related oxygenates to gasoline
[FE-1773-14] N77-11202
MOSHMAN ASSOCIATES, INC., BETHESDA, MD.
Evaluation of the feasibility of an independent HSA data base relative to proposed HSA budgets and staffing
[PB-254920/2] N77-11903
MOUND LAB., MIAMISBURG, OHIO.
Ultrasonic examination of thin iridium hemispheres for the multihundred watt heat source
[MLM-2291] N77-11419

N

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Resource and environmental surveys from space with the thematic mapper in the 1980's
[NASA-CR-149191] N77-11508
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[LR-591] N77-10999
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[NASA-TM-X-3457] N77-11044
Simulation of an automatically-controlled STOL aircraft in a microwave landing system multipath environment
[NASA-TM-X-73154] N77-11063
Conference on the Development of Fire-Resistant Aircraft Passenger Seats
[NASA-TM-X-73144] N77-11111
Intumescent coating containing 4,4'-dinitrosulfanilide
[NASA-CASE-ARC-11042-1] N77-11119
Laser velocimetry applied to transonic and supersonic aerodynamics
N77-11224
Evaluation of mean and turbulent velocity measurements in subsonic accelerated boundary layers
[NASA-TN-D-8367] N77-11343
Angle detector
[NASA-CASE-ARC-11036-1] N77-11364
Investigating complex aerodynamic flows with a laser velocimeter
[NASA-TM-X-73171] N77-11390

Pilot workload and fatigue: A critical survey of concepts and assessment techniques
[NASA-TN-D-8365] N77-11674
First-Order-hold interpolation digital-to-analog converter with application to aircraft simulation
[NASA-TN-D-8331] N77-11693

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. HUGH L. DRYDEN FLIGHT RESEARCH CENTER, EDWARDS, CALIF.

Window comparator
[NASA-CASE-FRC-10090-1] N77-11296

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.

Absolute rate of the reaction of C I[2P] with methane from 200-500 K
[NASA-TM-X-71221] N77-11136
Radiation from a current filament driven by a traveling wave
[NASA-TN-D-8302] N77-11294
LANDSAT 2: Cumulative Non-US Standard Catalog, 1975 - 1976
[NASA-TM-X-74212] N77-11481
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[NASA-TM-X-74217] N77-11482
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LANDSAT: Non-US Standard Catalog
[NASA-TM-X-74215] N77-11522
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[NASA-TM-X-74216] N77-11523
The covariance of temperature and ozone due to planetary-wave forcing
[NASA-TM-X-71212] N77-11613
Water vapor in the lower stratosphere measured from aircraft flight
[NASA-TM-X-71220] N77-11618
Initiation of non-tropical thunderstorms by solar activity
[NASA-TM-X-71222] N77-11635
Tabulation of hybrid theory calculated e-N2 vibrational and rotational cross sections
[NASA-TN-D-8347] N77-11830
Spectra of Her X-1 near a turn-on in the 35-day cycle
[NASA-TM-X-71213] N77-11935
A photometric study of the Orion OB 1 association. 2: Photometric analysis
[NASA-TM-X-71217] N77-11936
Observations at the planet Mercury by the plasma electron experiment, Mariner 10
[NASA-TM-X-71210] N77-11944
A comparison of the composition of new and evolved comets
[NASA-TM-X-71215] N77-11945
Radio observations of interplanetary magnetic field structures out of the ecliptic
[NASA-TM-X-71223] N77-11947
The relationship between the galactic matter distribution, cosmic ray dynamics, and gamma ray production
[NASA-TM-X-71224] N77-11965

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEX.

ASTP chemical and microbiological analysis of potable water
[NASA-TM-X-58192] N77-11675

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, LANGLEY STATION, VA.

Heat-transfer distributions on a 0.013-scale shuttle solid rocket booster at Mach 3.70 and angles of attack from 0 deg to 180 deg
[NASA-TM-X-3417] N77-10995
Effects of jets, wakes, and vortices on lifting surfaces
[NASA-TM-X-73974] N77-10998
A flight investigation of piloting techniques and crosswind limitations during visual STOL-type landing operations
[NASA-TN-D-8284] N77-11001
Preliminary sizing and performance evaluation of supersonic cruise aircraft
[NASA-TM-X-73936] N77-11031
Landing practices of general aviation pilots in single-engine light airplanes
[NASA-TN-D-8283] N77-11033
The Langley thermal protection system test facility: A description including design operating boundaries
[NASA-TM-X-73973] N77-11067
Mach 4 free-jet tunnel starting experiments for a hypersonic research engine model causing high blockage
[NASA-TM-X-3418] N77-11069
Effects of modifications to the space shuttle entry guidance and control systems
[NASA-TN-D-8273] N77-11087
A spectral reflectance estimation technique using multispectral data from the Viking lander camera
[NASA-TN-D-8292] N77-11099
Airborne antenna polarization study for the microwave landing system
[NASA-TM-X-73952] N77-11266
Systematic study of error sources in supersonic skin-friction balance measurements
[NASA-TN-D-8291] N77-11339
Numerical solution of supersonic three-dimensional free-mixing flows using the parabolic-elliptic Navier-Stokes equations
[NASA-TN-D-8195] N77-11342
A device for rapid determination of thermophysical properties of phase-change wind-tunnel models
[NASA-TM-X-3421] N77-11346
Weld-bonded titanium structures
[NASA-CASE-LAR-11549-1] N77-11397
An experimental study for determining human discomfort response to roll vibration
[NASA-TN-D-8266] N77-11666
The acoustic monopole in motion
[NASA-TM-X-73985] N77-11816

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OHIO.

Performance and boundary-layer evaluation of a sonic inlet
[NASA-TN-D-8340] N77-11004
Two-dimensional cold-air cascade study of a film-cooled turbine stator blade. 3: Effect of hole size on single-row and multirow ejection
[NASA-TM-X-3442] N77-11007
Performance of 1.15-pressure-ratio fan stage at several rotor blade setting angles with reverse flow
[NASA-TM-X-3451] N77-11008
Simulation of flight-type engine fan noise in the NASA-Lewis 9X15 anechoic wind tunnel
[NASA-TM-X-73540] N77-11050
Effects of forward velocity on noise for a J85 turbojet engine with multitube suppressor from wind tunnel and flight tests
[NASA-TM-X-73542] N77-11051
Macroscopic study of time unsteady noise of an aircraft engine during static tests
[NASA-TM-X-73556] N77-11052
Core noise source diagnostics on a turbofan engine using correlation and coherence techniques
[NASA-TM-X-73535] N77-11053
Performance and emission characteristics of swirl-can combustors to near-stoichiometric fuel-air ratio
[NASA-TN-D-8342] N77-11056
Method of discrete modeling and its application to estimation of TF30 engine variables
[NASA-TM-X-3443] N77-11057
Compensated control loops for a 30-cm ion thruster
[NASA-TM-X-73497] N77-11100
Long lifetime hollow cathodes for 30-cm mercury ion thrusters
[NASA-TM-X-73523] N77-11101
Cycle life testing of 8-cm mercury ion thruster cathodes
[NASA-TM-X-73526] N77-11102
Performance documentation of the engineering model 30-cm diameter thruster
[NASA-TM-X-73530] N77-11103
Sputtering phenomena of discharge chamber components in a 30-cm diameter Hg ion thruster
[NASA-TM-X-73533] N77-11104
High reliability cathode heaters for ion thrusters
[NASA-TM-X-73538] N77-11105
Electron bombardment propulsion system characteristics for large space systems
[NASA-TM-X-73554] N77-11106
Effect of fiber diameter and matrix alloys on impact-resistant boron/aluminum composites
[NASA-TN-D-8204] N77-11118
Hot hardness of nickel-rich nickel-chromium-aluminum alloys
[NASA-TM-X-3429] N77-11155
Evaluation of potassium titanate as a component of alkaline fuel cell matrices
[NASA-TN-D-8341] N77-11175
Design study of steady-state 30-tesla liquid-neon-cooled magnet
[NASA-TN-D-8337] N77-11213
Test program for transmitter experiment package and heat pipe system for the communications technology satellite
[NASA-TM-X-3455] N77-11268
Description and expected performance of flight-model, 12-gigahertz, output stage tube for the communications technology satellite
[NASA-TM-X-3441] N77-11295
Scanning radiometer for measurement of forward-scattered light to determine mean diameter of spray particles
[NASA-TM-X-3454] N77-11366
Considerations to achieve directionality for gamma ray lasers
[NASA-TM-X-73580] N77-11389
Isothermal elastohydrodynamic lubrication of point contacts. III: Fully flooded results
[NASA-TN-D-8317] N77-11400
Nonaxisymmetric incompressible hydrostatic pressure effects in radial face seals
[NASA-TN-D-8343] N77-11401
Optimum step design for centering of pistons moving in an incompressible fluid
[NASA-TN-D-8345] N77-11402
Cyclic structural analysis of air-cooled gas turbine blades and vanes
[NASA-TM-X-73494] N77-11439
Rim-spoke composite flywheels: Stress and vibration analysis
[NASA-TN-D-8339] N77-11442
Optimized selective coatings for solar collectors
[NASA-TM-X-73498] N77-11529
Evaluation of flat-plate collector efficiency under controlled conditions in a solar simulator
[NASA-TM-X-73520] N77-11530
Global measurements of gaseous and aerosol trace species in the upper troposphere and lower stratosphere from daily flights of 747 airliners
[NASA-TM-X-73544] N77-11612
Potential biomedical applications of ion beam technology
[NASA-TM-X-73512] N77-11655
Centroid and moments of an area using a digitizer
[NASA-TM-X-73528] N77-11718
OTW noise correlation for several nozzle/wing geometries using a 5:1 slot nozzle with external deflectors
[NASA-TM-X-73529] N77-11815
Modal density function and number of propagating modes in ducts
[NASA-TM-X-73539] N77-11817
Vocabulary of aerospace safety terms pertaining to cryogenic safety, fires, explosions, and structure failure
[NASA-TM-X-73521] N77-11901
Cost-benefit analysis of space technology
[NASA-TM-X-3453] N77-11908

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.

Tetherline system for orbiting satellites
[NASA-CASE-MFS-23564-1] N77-11079
The eigenvalue spectrum of the Orr-Sommerfeld problem
[NASA-TR-R-469] N77-11344
Spherical bearing
[NASA-CASE-MFS-23447-1] N77-11403
Meteorological regimes for the classification of aerospace air quality predictions for NASA-Kennedy Space Center
[NASA-TM-X-3450] N77-11570
The theoretical reflectance of X-rays from optical surfaces
[NASA-TN-D-8366] N77-11853

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. PASADENA OFFICE, CALIF.

Thin conformal antenna array for microwave power conversion
[NASA-CASE-NPO-13886-1] N77-11269
Differential optoacoustic absorption detector
[NASA-CASE-NPO-13759-1] N77-11363
Hydrogen-fueled engine
[NASA-CASE-NPO-13763-1] N77-11398

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An ALGOL program for the calculation of incompressible three dimensional turbulent boundary layers
[NLR-TR-74159-U] N77-11010
Calculation of the flow around a swept wing, taking into account the effect of the three-dimensional boundary layer. Part 1: Wing with turbulent boundary layer
[NLR-TR-75076-U] N77-11011
The establishment of safe separations between aircraft in flight
[NLR-MP-75041-U] N77-11020
The effect of finite test section length on wall interference in 2-D ventilated wind tunnels
[NLR-MP-75036-U] N77-11071
Design and performance of the four-degrees-of-freedom motion system of the NLR research flight simulator
[NLR-MP-75038-U] N77-11072
Analysis of the perturbed motion of asymmetric, spinning spacecraft
[NLR-TR-75043-U] N77-11097
Two dimensional MHD duct flow: Numerical analysis and measurements
[NLR-MP-75016-U] N77-11348
Comparison of data from two shock wave turbulent boundary layer interaction experiments
[AD-A024520] N77-11352
Calculation of vibration modes and resonance frequencies of the Northrop NF-5
[NLR-TR-75050-U] N77-11450
An hierarchic multi-suppliers computer network of a research laboratory with two settlements
[NLR-MP-75012-U] N77-11746

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Test and evaluation of the beacon processing subsystem of the Automated Radar Terminal Systems [ARTS III] all-digital tracking level system
[AD-A028514/8] N77-11025

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D.C.
Electron-microscopical studies of passive films on stainless steels
[PB-255190/1] N77-11168
Chemical breakdown of passivity
[PB-255102/4] N77-11169
Ellipsometric spectroscopic study of breakdown of Fe-Cr and Fe-Cr-Mo alloys
[PB-255203/2] N77-11170
Regional seminar on a system of standardization and metrology for Latin America
[PB-254469/0] N77-11214
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[PB-255803/9] N77-11216
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[PB-255809/6] N77-11217
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[PB-255864/1] N77-11218
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[NASA-CR-149193] N77-11367
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[PB-252400/7] N77-11378
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[PB-254475/7] N77-11379
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[PB-255539/9] N77-11381
Improved microwave-discharge source for UV photoemission
[PB-255204/0] N77-11382
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[PB-255209/9] N77-11383
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[PB-252798/4] N77-11394
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[PB-255075/4] N77-11459
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[PB-256425/0] N77-11471
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[PB-255054/9] N77-11726
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[VTI-52] N77-11919
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[AD-A024071] N77-11038
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N77-11647
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[AD-A024036] N77-11658
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[AD-A024510] N77-11220
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[AD-A025491] N77-11356
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N77-11264
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N77-11328
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N77-11418

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N77-11752

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N77-10996
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N77-11251
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N77-11433

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N77-11874

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N77-11877

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[ORNL-TM-5283] N77-11534

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[ONRL/HUD/MIUS-29-ADD-2] N77-11571

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[ORNL-CSD-TM-1] N77-11720

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[PB-254615/8] N77-11636

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N77-11650

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N77-11320

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N77-11427

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N77-11800

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[PB-245424/7] N77-11559

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N77-11133

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N77-11146

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N77-11250

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N77-11265

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N77-11483

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N77-11743

On the exponential map of a Lie group
N77-11805

Dynamics of inertia variant machinery
N77-11809

Magnetoelastic interactions in SmCo5
N77-11810

Conformal and non-Hertzian contact problems
N77-11811

Composition and equation of state of thermally dissociated matter and mass and stability of rigidly rotating relativistic polytropes
N77-11843

Microwave response of nonequilibrium superconductors
N77-11879

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N77-11900

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N77-11911

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[AD-A023678] N77-11179

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[AD-A023774] N77-11181

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N77-11285

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N77-11525

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N77-11245

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N77-11252

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N77-11262

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N77-11263

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N77-11284

ROM programmable cellular array
N77-11289

Orbital motion of dipoles in electromagnetic fields
N77-11330

Thermal boundary layer flow of absorbing and emitting high temperature air
N77-11333

A composite transer matrix-synthesis approach to piping dynamic analysis
N77-11334

Experimental investigation of coaxial turbulent jets
N77-11337

Resonant pressure instrumentation
N77-11358

Steady state response of shell structures
N77-11428

Automatic program testing
N77-11716

The systematic design of communications line control procedures
N77-11744

Optimal order reduction
N77-11745

Finite state equalization
N77-11762

Probability measures on algebras
N77-11780

Sequential partition detectors with applications
N77-11781

Radiation from a collection of absorbing resonant systems in the presence of boundaries of intense fields
N77-11828

A high performance, low cost, digitally driven electron beam lithography system
N77-11846

Periodic integrated optical structures in photoresist: Application to grating couplers
N77-11847

Diffraction by wedges and cones
N77-11848

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N77-11849

Mode properties in unstable optical resonators
N77-11850

Optical surface waveguide discontinuities
N77-11852

An experimental and theoretical study of the propagation of high amplitude pulses in a bounded magneto-plasma
N77-11861

Beam propagation and guiding in anisotropic media, layers and fibers
N77-11869

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N77-11872

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N77-11881

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N77-11891

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N77-11259
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N77-11260
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N77-11338
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N77-11436
POLYTECHNIC INST. OF NEW YORK, FARMINGDALE.
An HVDC breaker with sequential switching
N77-11286
Robust statistical techniques in pattern recognition: Gray-level and edge detection
N77-11753
PRATT AND WHITNEY AIRCRAFT, EAST HARTFORD, CONN.
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[NASA-CR-135103] N77-11154
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[AD-A024425] N77-11160
PRATT INST., BROOKLYN, N.Y.
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[PB-255541/5] N77-11929
PRINCETON UNIV., N.J.
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N77-11173
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[AD-A023822] N77-11180
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N77-11236
Resonant Doppler velocimeter
N77-11239
Finite wordlength in digital signal processing
N77-11255
An experimental study of compressible turbulent boundary layer separation at high Reynolds numbers
N77-11321
Development of the electron beam fluorescence technique for measurements in a hypersonic turbulent flow
N77-11326
On the logarithms of high order spacings
[AD-A023716] N77-11770
Inelastic neutron scattering in solid neon at high pressure
N77-11829
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N77-11842
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N77-11862
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N77-11943
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[AD-A024286] N77-11689
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[AD-A024004] N77-11059
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[PB-252887/5] N77-11215
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N77-11240
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Q

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[PB-256411/0] N77-11933

R

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[PB-255858/3] N77-11574
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[PB-254427/8] N77-11607
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[NASA-CR-150061] N77-11916
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[AD-A023681] N77-11023
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[PB-252914/7] N77-11926
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[PB-254925/1] N77-11516
RICE UNIV., HOUSTON, TEX.
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N77-11110
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N77-11131
On the kinetics and thermodynamics of metallic solid solutions
N77-11150
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N77-11151
A hydrodynamic stability analysis of some proposed model equations for biofluids
N77-11322
Dynamic behavior of fluid-tank systems
N77-11325
Numerical determination of minimum mass structures with specified natural frequencies
[AD-A023655] N77-11463
Large scale atmospheric electric fields: Comparisons with balloon data
N77-11608
Time variations of HF induced plasma waves
N77-11611
A hierarchical restructurable multi-microprocessor architecture
N77-11692
Higher K-theory of regular rings
N77-11804
Collisional ionization of xenon atoms in well defined high Rydberg states
N77-11826
Static magnetic properties of DC biased RF sputtered GdFe amorphous films
N77-11871
The thermodynamics and kinetics of interstitial solid solutions
N77-11883
Escape of charged particles from a neutron star
N77-11934
The lunar exosphere
N77-11949
The Apollo 17 infrared scanning radiometer
N77-11950
Solar wind induced currents in the atmospheres of non-magnetic planets
N77-11953
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N77-11959
Observations of plasma in the geomagnetic tail at lunar distances
N77-11961
ROCK ISLAND ARSENAL, ILL.
Shot peening procedures for helical compression springs
[AD-A023758] N77-11415
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N77-11825
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[AD-A024487] N77-11065
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N77-11648
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N77-11226
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N77-11231
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[TRITA-EPP-75-19] N77-11864
Velocity limitations in coaxial plasma gun experiments with gas mixtures
[TRITA-EPP-76-02] N77-11865
ROYAL NETHERLANDS AIRCRAFT FACTORIES FOKKER, SCHIPHOL-OOST.
Crack growth data of 2024-T3-clad as determined in Fokker report R-1764 and in NLR report TN-M2092
[FOK-R-1814] N77-11120
Corrosion behaviour of mixed laminates [CFRP core with both 7075-T6 clad and 5052-H38 faces]
[FOK-R-1868] N77-11121
Certification of the replacement of glass fabric per mat. spec. 5.670/1, with glass fabric per mat. spec. 5.670 in the F27 plastic sandwich wing-and-stabilizer-leading edges
[FOK-R-1876] N77-11122
Compressive test method for fiber reinforced composites
[FOK-R-1877] N77-11123
Investigation into the influence of natural weathering on the fire resistant property of FFP 5.552 [F-coat]
[FOK-R-1932] N77-11176
Research on adhesive bonding and surface characteristics of metals at Fokker-VFW
[FOK-R-1816] N77-11405
Fracture toughness tests on compressive preloaded specimens with a thickness of 5 mm
[FOK-R-1839] N77-11448
Fracture toughness of 8mm 2024-T3 non clad plate with long central cracks
[FOK-R-1879] N77-11449
ROYAL NETHERLANDS METEOROLOGICAL INST., THE HAGUE.
On the theory of the electromagnetic seismograph
[KNMI-102-95] N77-11619
RUHR UNIV., BOCHUM [WEST GERMANY].
Current problems of optical interferometry used in experimental gas dynamics
N77-11244

S

SAINT LOUIS UNIV., MO.
Some effects of the shearing and veering environmental flow on the internal dynamics and structure of a severe thunderstorm during its mature stage
N77-11633
SANDIA LABS., ALBUQUERQUE, N.MEX.
Electrical characteristics for rectangular conductors
[SAND-75-0626] N77-11297
Solar radiation availability to various collector geometries: A preliminary study
[SAND-76-0009] N77-11537

Brief instructions for using MATHLIB [version 6.0] [SAND-75-0545] N77-11721

SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TEX.
Changes in clinical cardiologic measurements associated with high +G sub z stress N77-11645
Ventricular pathology in swine at high sustained +G sub z N77-11646
The use of a fixed base simulator as a training device for high sustained or ACM [Air Combat Maneuvering] +G sub z stress N77-11652
Principles of biodynamics. Volume 3: Physiological mechanisms in the mammal underlying posture, locomotion, and orientation in space [AD-A023691] N77-11661
The effect of 1.6 GHz radiation on neurotransmitters in discrete areas of the rat brain [AD-A023677] N77-11662

SCHWEIZERISCHER VERBAND FUER DIE MATERIALPRUEFUNG DER TECHNIK [SVMT], DUEBENDORF [SWITZERLAND].
Mechanism of material fatigue during the crack initiation stage [ICAF-DOC-895] N77-11441

SCIENCE UNIV. OF TOKYO [JAPAN].
Investigation of environmental change pattern in Japan [E77-10025] N77-11488

SCIENTIFIC TRANSLATION SERVICE, SANTA BARBARA, CALIF.
Description of the universal program for calculating the navigational information on the location of an artificial earth satellite [NASA-TT-F-17273] N77-11093
Contributions to the study of the physical properties of carbon [NASA-TT-F-17246] N77-11117
Morphostructural methods of studying the tectronics of enclosed platforms, petroleum-gas-bearing regions [NASA-TT-F-16734] N77-11615
Equipment for the cosmonaut [NASA-TT-F-17275] N77-11670

SERVICE TECHNIQUE DE L'AERONAUTIQUE, PARIS [FRANCE].
Military rocket aircraft: Inherent constraints and their uses N77-11186

SERVICIO GEOLOGICO DE BOLIVIA, LA PAZ.
The 29950 Earth Resource Technology Satellite [ERTS-A] sensor data for mineral resource sector development and regional land use survey, March - August 1976 [E77-10028] N77-11491

SHELDAHL CO., NORTHFIELD, MINN.
Solar power array for the concentration of energy. Task 2: Modifications to a specular photometer [COO-2699-3] N77-11538

SIAM INST. FOR MATHEMATICS AND SOCIETY, PHILADELPHIA, PA.
Mathematics for energy [PB-252463/5] N77-11543

SIEMENS A.G., MUNICH [WEST GERMANY].
New storage tubes [BMFT-FB-T-76-02] N77-11298
New methods for improving the stability of power diodes [BMFT-FB-T-76-09] N77-11300
Destruction by avalanche burnout [BMFT-FB-T-76-14] N77-11303
Thin film circuits for future applications. Part 1: Basic investigations and sputtering technique [BMFT-FB-T-76-20] N77-11306
Thin film circuits for future applications. Part 2: Evaporation technique [BMFT-FB-T-76-21] N77-11307

SOLAR, SAN DIEGO, CALIF.
Study of erosion mechanisms of engineering ceramics [AD-A025258] N77-11184

SOUTH CAROLINA UNIV., COLUMBIA.
Hydrodynamic aspects of the critical heat flux in subcooled convection boiling N77-11329
System identification techniques using the group method of data handling N77-11713

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY.
Thermal conductivity of heavily doped p-type indium antimonide N77-11876

SOUTHERN RESEARCH INST., BIRMINGHAM, ALA.
Particulate collection efficiency measurements on an electrostatic precipitator installed on a paper mill recovery boiler [PB-255297/4] N77-11596
Evaluation of Rexnord gravel bed filter [PB-255095/2] N77-11597

SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX.
Investigation of stress levels causing significant damage in composites [AD-A024537] N77-11127
Additional energy solutions for predicting structural deformations [AD-A024591] N77-11464
Estimates of blowdown of quasi-static pressures in vented chambers [AD-A025502] N77-11479
Estimating external blast loads from suppressive structures [AD-A025503] N77-11480

STANDARD ELECTRIK LORENZ A.G., STUTTGART [WEST GERMANY].
Analysis of economics of a TV broadcasting satellite for additional nationwide TV programs [BMFT-FB-T-76-05] N77-11270

STANFORD RESEARCH INST., ARLINGTON, VA.
Meeting report: Advanced fossil fuels sector group [PB-255117/4] N77-11549

STANFORD RESEARCH INST., MENLO PARK, CALIF.
Aircraft ground fire suppression and rescue systems. Characteristics of kinematic jet fuel fires cascading and rod fuel geometries [AD-A024447] N77-11022
Passivation of pigment particles for thermal control coatings [NASA-CR-150046] N77-11174
Research to anticipate environmental impacts of changing resource usage [PB-256293/2] N77-11602
A verification system for JOVIAL/J3 programs [Rugged Programming Environment: RPE/1] [AD-A024395] N77-11730

STANFORD UNIV., CALIF.
Applied research on II-VI compound [PB-254637/2] N77-11547
Proceedings of the Workshop on Modeling the Interrelationships between the Energy Sector and the General Economy [PB-255696/7] N77-11561
Heat treatment of refuse for increasing anaerobic biodegradability [PB-252924/6] N77-11577
Comment on 'Kp dependence on sectors, by I. B. McDiarmid and E. E. Budzinski [NASA-CR-149176] N77-11624
Continuing research in the development of interactive man-computer systems for engineering-construction projects [PB-252927/9] N77-11679
Computer graphics applications in transportation information systems [PB-254795/8] N77-11696
An efficient implementation of monitors and condition variables [AD-A023931] N77-11697
Photon limited images and their restoration [AD-A024027] N77-11700
Interplanetary sector structure 1947 - 1975 [NASA-CR-149175] N77-11948
The Hale solar sector boundary [NASA-CR-149173] N77-11955
Three-dimensional structure of the extended solar magnetic field and the sunspot cycle variation in cosmic ray intensity [NASA-CR-149174] N77-11956

STANFORD UNIV., PALO ALTO, CALIF.
Partially observable Markov decision processes over an infinite planning horizon with discounting [AD-A025077] N77-11778
Biomedical technology transfer: Applications of NASA science and technology N77-11915

STATE UNIV. OF NEW YORK, BUFFALO.
Susceptibility of UHF RF transistors to high power UHF signals, part 2 [AD-A024394] N77-11316

SUSQUEHANNA RIVER BASIN COMMISSION, HARRISBURG, PA.
Technical manual for estimating low-flow frequency characteristics of streams in the Susquehanna River basin [PB-255455/8] N77-11512

SYDNEY UNIV. [AUSTRALIA].
Cracking in concrete: Attributed to defects in construction [PB-252920/4] N77-11451

SYRACUSE UNIV., N.Y.
Diffusion in transition metals and alloys and selective adsorption and hydrogen embrittlement N77-11144
Analysis of arbitrarily oriented thin wire antenna arrays over imperfect ground planes N77-11254
Response of linear discrete systems to modulated sequences N77-11258
A study of electromigration in microwave power transistors N77-11290
Fourier integral methods for static and dynamic problems in microstrip N77-11293
The permeation of gases through polyethylene membranes at high pressures. A free-volume model of permeation N77-11323
Stiffness and stress analysis of discretely attached corrugated shear webs with quasi-sinusoidal corrugations N77-11434
Commercial building unitary heat pump system with solar heating [PB-255488/9] N77-11551
Receptor contributions to steady-state sensitivity in the peripheral retina of human observers N77-11654
System design of functional memory based processors N77-11691
A study of fast transform algorithms N77-11709
Some results in majority decoding of binary cyclic codes N77-11711
Solution of networks containing a trichotomized class of elements N77-11714
An optimal algorithm for testing random access memories [AD-A023894] N77-11732
Parallel multitonic sorting networks [AD-A024392] N77-11749
Associative processing of network flow problems [AD-A024380] N77-11750
Second harmonic generation in a bounded magnetoplasma N77-11860
The epitaxial growth of thin films and the interfacial dislocations studied by RHEED and transmission electron microscopy N77-11868

SYSTEMS APPLICATIONS, INC., SAN RAFAEL, CALIF.
Analysis of the data from the three-dimensional gradient study [PB-253936/9] N77-11578
Theoretical, numerical, and physical techniques for characterizing power plant plumes [PB-253099/6] N77-11599

SYSTEMS RESEARCH LABS., INC., DAYTON, OHIO.
Comparison of human information processing performance with DOT and stroke alphabetic characters [AD-A024099] N77-11686

SYSTEMS SCIENCE AND SOFTWARE, HAYWARD, CALIF.
Repetitively pulsed cold cathode studies [AD-A024354] N77-11317

T

TECHNISCH PHYSISCH DIENST TNO-TH, DELFT [NETHERLANDS].
The use of rotating radial diffraction gratings in laser Doppler velocimetry N77-11242

TECHNISCHE HOGESCHOOL, DELFT [NETHERLANDS].
Computational results of the NISLAP and AIM-LASER programs for satellite position predictions [VTH-212] N77-11080

TECHNISCHE UNIV., BERLIN [WEST GERMANY].
Laser applications in flight control N77-11391

TECHNOLOGICAL LAB. RVO-TNO, RIJSWIJK [NETHERLANDS].
Simple determination of the mechanical behavior of double base rocket propellants under high loading rates N77-11195

TECHTRAN CORP., GLEN BURNIE, MD.
Earth magnetism, the aurora and ultralow-frequency radiation [NASA-TT-F-16737] N77-11616

TEL-AVIV UNIV. [ISRAEL].
Multidimensional difference schemes with fourth order accuracy [AD-A023766] N77-11771

TEMPLE UNIV., PHILADELPHIA, PA.
On semiuniform weakly inverse semigroups and semiuniform inverse semigroups N77-11799
Homogeneous cosmologies with strong neutrino fields N77-11844

TENNESSEE TECHNOLOGICAL UNIV., COOKEVILLE.
On the convection limited self-sustained acoustic vibrations in a closed cylindrical chamber N77-11359

Nonlinear analyses of the stress field near a crack or hole in a plate
N77-11430

TENNESSEE UNIV., KNOXVILLE.
Programmable data collection platform study
[NASA-CR-144819] N77-11086
Transportation planning for small urban areas
[PB-256119/9] N77-11932

TETRA TECH, INC., ARLINGTON, VA.
Energy use in the contract construction industry
[PB-245422/1] N77-11557
Energy use in the contract construction industry. Appendix A: Study methodology
[PB-245423/9] N77-11558

TEXAS A&M RESEARCH FOUNDATION, COLLEGE STATION.
Compilation of stratospheric trace gas spectral parameters
[AD-A025490] N77-11632

TEXAS TECHNOLOGICAL UNIV., LUBBOCK.
Paths of movement for selected body segments during typical pilot tasks
[AD-A025773] N77-11520
Design of stochastic linear control systems according to cumulant based performance criteria
[AD-A025078] N77-11795

TEXAS TRANSPORTATION INST., COLLEGE STATION.
Thermal activity of base course material related to pavement cracking
[PB-254754/5] N77-11476

TEXAS UNIV., AUSTIN.
Mixed-hybrid finite element approximations of second-order elliptic boundary-value problems
[ORO-3443-59] N77-11766

TEXAS UNIV., DALLAS.
A new atmospheric diffusion model
N77-11609
Determination of cosmic ray muon intensities deep underground
N77-11960

TEXAS UNIV., GALVESTON.
Coronary flow and myocardial biochemical responses to high sustained +G sub z acceleration
N77-11649

TEXAS UNIV. HEALTH SCIENCE CENTER, HOUSTON.
Potential role of remote sensing in disaster relief management
[NASA-CR-149102] N77-11502

TORONTO UNIV. [ONTARIO].
Lateral vibrations of an extending rod
[UTIAS-TN-202] N77-11438

TRACOR SCIENCES AND SYSTEMS, AUSTIN, TEX.
Airport noise monitoring systems, task A
[AD-A028511/4] N77-11821

TRANSEMANTICS, INC., WASHINGTON, D.C.
Viscous interaction with separation in transonic flow
[NASA-TT-F-17187] N77-10997
Secondary flow in axisymmetric compressors
[NASA-TT-F-15497] N77-11009
Toward new heights
[NASA-TT-F-17248] N77-11019
Calculation of multi-contour thin-walled structures by the method of sections
[NASA-TT-F-17284] N77-11029
Industrial development of silicon solar cells
[NASA-TT-F-17139] N77-11528
A new atmospheric model and earth-satellite motion
[NASA-TT-F-17108] N77-11614
Conditionally effective evaluations of the parameters of nonlinear models
[NASA-TT-F-17264] N77-11785
Application of the maximum plausibility method to the problem of determination of the intensities of an intermixed poisson flux
[NASA-TT-F-17265] N77-11786
Neutrino astrophysics
[NASA-TT-F-17249] N77-11946
Modeling dynamic processes in planetary atmospheres. Part I: Apparatus for studying shear flow stability in spherical layers, preliminary results
[NASA-TT-F-17262] N77-11951

TRANSPORTATION RESEARCH BOARD, WASHINGTON, D.C.
Optimizing the use of materials and energy in transportation construction
[PB-253713/2] N77-11475
Planning and programming for transportation
[PB-255637/1] N77-11925

TRW DEFENSE AND SPACE SYSTEMS GROUP, REDONDO BEACH CALIF.
Flexible, FEP-Teflon covered solar cell module development
[NASA-CR-135109] N77-11531

TRW, INC., LAWNDALE, CALIF.
Top collector contacted microwave power transistor; monolithic microwave lumped element integrated circuit program, phase I
[AD-A023829] N77-11313

TRW SYSTEMS GROUP, REDONDO BEACH, CALIF.
Weld-bonded titanium structures
[NASA-CASE-LAR-11549-1] N77-11397
Field test sampling/analytical strategies and implementation cost estimates: Coal gasification and flue gas desulfurization
[PB-254166/2] N77-11581

U

UMPQUA RESEARCH CO., MYRTLE CREEK, ORE.
Electrolytic pretreatment unit gaseous effluent conditioning
[NASA-CR-151101] N77-11671
Development assessment of wash water reclamation
[NASA-CR-137934] N77-11676

UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CONN.
Development of directionally solidified eutectic nickel and cobalt alloys
[AD-A024420] N77-11165
Simultaneous laser measurements of instantaneous velocity and concentration in turbulent mixing flows
N77-11247
The inviscid pressure field on the tip of a semi-infinite wing and its application to the formation of a tip vortex
[NASA-CR-2748] N77-11345
Calculation of energetics of selected atmospheric systems. Theoretical study of dissociative-recombination of e + NO[+]
[AD-A024309] N77-11629

URBAN INST., WASHINGTON, D.C.
The consequences of transit fare and service policies: A classified bibliography
[PB-253101/0] N77-11931

URBAN MASS TRANSPORTATION ADMINISTRATION, WASHINGTON, D.C.
Future scenarios for urban transportation
[PB-255349/3] N77-11930

UTAH DEPT. OF TRANSPORTATION, SALT LAKE CITY.
Improvement of Utah's flexible pavement performance system
[PB-254819/6] N77-11462

V

VALVO G.M.B.H., HAMBURG [WEST GERMANY].
Nonvolatile analog memories with ferroelectric elements
[BMFT-FB-T-76-11] N77-11302

VANDERBILT UNIV., NASHVILLE, TENN.
On the nature of the closure phenomena and its effect on fatigue crack growth rate
N77-11431
Characterization of fatigue cracks with ultrasonics
N77-11432
Almost completely decomposable groups
N77-11801
Measurements of energy losses, distributions of energy loss and additivity of energy losses for 50 to 150 KeV protons in hydrogen and nine hydrocarbon gases
N77-11823

VDEH-INSTITUT FUER ANGEWANDTE FORSCHUNG G.M.B.H., DUESSELDORF [WEST GERMANY].
Further development of a method for measuring velocity and length by laser technology
[BMFT-FB-T-76-17] N77-11377

VIRGINIA INST. OF MARINE SCIENCE, GLOUCESTER POINT.
An assessment of estuarine and nearshore marine environments
[PB-254853/5] N77-11598

VIRGINIA POLYTECHNIC INST., BLACKSBURG.
Rate and time dependent behavior of structural adhesives
N77-11112

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Nonlinear analysis of laminated fibrous composites
N77-11113
Aerobic biological treatment of a colloidal wastewater
N77-11568
Penetration and mixing of heated discharges into waterways
[PB-253957/5] N77-11580
Computerized analysis of eye movements during static display visual search
[AD-A024100] N77-11680
The census and transportation planning: Survey of evaluations and recommendations as to the usefulness of the 1970 census data in urban transportation planning
[PB-254802/2] N77-11924

VIRGINIA UNIV., CHARLOTTESVILLE.
The oxidation of T-111 alloy at high termperatures and low pressures
N77-11145
Local instability of sandwich plates
N77-11426
High spin states in Mg-26 and Na-23 populated by heavy ion reactions
N77-11838
Transformation of high energy electrons to muons in the Coulomb field of a nucleus
N77-11841

VISIDYNE, INC., BURLINGTON, MASS.
A study of X-ray emission from laser heated plasma
[AD-A025498] N77-11866

VON KARMAN INST. FOR FLUID DYNAMICS, RHODE-SAINT-GENESE [BELGIUM].
Analysis of the ouput data of a laser Doppler velocimeter
N77-11229

VOUGHT CORP., DALLAS, TEX.
Development and fabrication of an advanced liquid cooling garment
[NASA-CR-137974] N77-11673

W

WASHINGTON STATE UNIV., PULLMAN.
Societal implications of energy scarcity. Social and technological priorities in steady state and constricting systems
[PB-253097/0] N77-11556
Numerical solution of two-dimensional integral equations using linear elements
[AD-A023693] N77-11772

WASHINGTON UNIV., SEATTLE.
Nonlinear optimization and generalized Lagrange multipliers
[AD-A024413] N77-11793
Assessing the relationship between urban form and travel requirements: A literature review and conceptual framework
[PB-254988/9] N77-11923

WATERVLIET ARSENAL, N.Y.
Simple thickness modes and shear correction coefficients for viscoelastic Timoshenko beams
[AD-A023771] N77-11125

WESLEYAN UNIV., MIDDLETOWN, CONN.
Shape analysis of pulsed second sound in superfluid helium
N77-11210
A new method for measuring the Newtonian gravitational constant, G
N77-11807

WEST VIRGINIA UNIV., MORGANTOWN.
The use of an interactive energy model for technology assessment with special reference to underground coal gasification
[PB-255543/1] N77-11545

WESTINGHOUSE DEFENSE AND ELECTRONIC SYSTEMS CENTER, BALTIMORE, MD.
Final approach performance monitor
[AD-A028513/0] N77-11024

WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.
Methodology development for statistical evaluation of reactor safety analyses
[PB-255408/7] N77-11550

WISCONSIN UNIV., MADISON.
A canonical analysis of multiple time series
[AD-A023861] N77-11773
Some aspects of bivariate regression subject to linear constraints
[AD-A024255] N77-11794

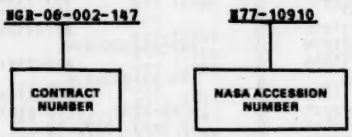
Y

YALE UNIV., NEW HAVEN, CONN.
Research on a high level language approach to operating system design
[AD-A023866] N77-11733

Z

ZURICH UNIV. [SWITZERLAND].
Digital image processing
[E77-10035] N77-11496

Typical Contract Number Index Listing



Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

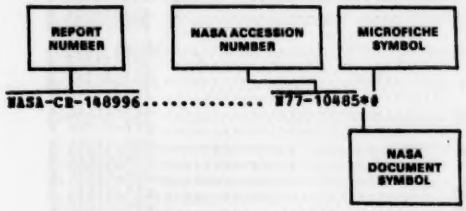
AF PROJ. 572C
N77-11751
AF PROJ. 921E
N77-11098
AF PROJ. 1367
N77-11478
AF PROJ. 1929
N77-11042
AF PROJ. 1989
N77-11035
AF PROJ. 2128
N77-11314
AF PROJ. 2646
N77-11700
AF PROJ. 2765
N77-11855
AF PROJ. 3048
N77-11140
N77-11318
AF PROJ. 3066
N77-11062
AF PROJ. 3145
N77-11058
AF PROJ. 3202
N77-11524
AF PROJ. 3205
N77-11628
AF PROJ. 4506
N77-11282
AF PROJ. 4594
N77-11731
AF PROJ. 4643
N77-11621
AF PROJ. 5519
N77-11732
AF PROJ. 5573
N77-11308
N77-11311
AF PROJ. 5581
N77-11698
N77-11730
N77-11749
N77-11750
AF PROJ. 5597
N77-11699
AF PROJ. 5621
N77-11832
AF PROJ. 6813
N77-11061
N77-11620
N77-11854
AF PROJ. 7021
N77-11160
AF PROJ. 7071
N77-11796
AF PROJ. 7116
N77-11354
AF PROJ. 7151
N77-11697
AF PROJ. 7183
N77-11680
AF PROJ. 7184
N77-11043
N77-11686
N77-11689
AF PROJ. 7340
N77-11127
AF PROJ. 7342
N77-11183
AF PROJ. 7367
N77-11834
AF PROJ. 7600
N77-11938
AF PROJ. 7601
N77-11626
AF PROJ. 7670
N77-11632
AF PROJ. 7757
N77-11662
AF PROJ. 7903
N77-11456
AF PROJ. 7905
N77-11014
AF PROJ. 7930
N77-11661
AF PROJ. 8219
N77-11015
AF PROJ. 8600
N77-11620
AF PROJ. 8603
N77-11939
AF PROJ. 8604
N77-11775
AF PROJ. 9567
N77-11316
AF PROJ. 9711
N77-11060
N77-11854
AF PROJ. 9749
N77-11463
N77-11793
AF PROJ. 9761
N77-11172
AF PROJ. 9767
N77-11352
AF PROJ. 9769
N77-11774
AF PROJ. 9777
N77-11656
N77-11664
AF PROJ. 9778
N77-11687
AF PROJ. 9781
N77-11013
N77-11061
N77-11412
N77-11771
AF-AFOSR-2167-72
N77-11061
AF-AFOSR-2185-72
N77-11463
AF-AFOSR-2268-72
N77-11774
AF-AFOSR-2269-72
N77-11793
AF-AFOSR-2370-72
N77-11771
AF-AFOSR-2511-73
N77-11060
AF-AFOSR-2526-73
N77-11664
AF-AFOSR-2570-73
N77-11688
AF-AFOSR-2641-74
N77-11172
AF-AFOSR-2802-75
N77-11412
AF-AFOSR-2815-75
N77-11352
ARO PROJ. P32A-33A
N77-11037
ARO PROJ. P41T-78A
N77-11037
ARO PROJ. V41A-84A
N77-11015
ARO PROJ. V41B-82A
N77-11098
ARPA ORDER 600
N77-11856
ARPA ORDER 1807
N77-11393
ARPA ORDER 2182
N77-11889
ARPA ORDER 2284
N77-11778
ARPA ORDER 2397
N77-11394
ARPA ORDER 2444
N77-11858
ARPA ORDER 2466
N77-11759
ARPA ORDER 2574
N77-11166
ARPA ORDER 2646
N77-11700
ARPA ORDER 2750
N77-11278
ARPA ORDER 2765
N77-11855
AT(29-1)-789 N77-11297
N77-11537
N77-11721
AT(40-1)-3443
N77-11766
AT(49-15)-3063
N77-11108
BMFT-512-8791-WRT-4054
N77-11073
CEG-404/187/22
N77-11406
DA PROJ. D01-61102-BB-349
N77-11141
DA PROJ. 1F1-63204-DB-38
N77-11041
DA PROJ. 1R7-65706-M-541
N77-11779
DA PROJ. 1S7-62705-AH-94
N77-11310
DA PROJ. 1T0-61101-A-91A
N77-11181
DA PROJ. 1T1-61102-A-33D
N77-11016
DA PROJ. 1T1-61102-A-33H
N77-11018
DA PROJ. 1T1-61102-AH-46
N77-11682
DA PROJ. 1T1-61102-B-52A
N77-11416
DA PROJ. 1T1-62105-AH-84
N77-11126
DA PROJ. 1T1-62114-AH-73
N77-11388
DA PROJ. 1W1-62118-AH-75
N77-11701
DA PROJ. 1W3-62306-AH-72
N77-11128
DA PROJ. 200-61102-A-14D
N77-11777
DA PROJ. 4A1-621-A-896
N77-11582
DA PROJ. 4A1-61102-B-52
N77-11627
DA PROJ. 4A7-62720-A-896
N77-11519
DA PROJ. 6A7-65706-M-985
N77-11182
DA-ARO(D)-31-124-72-G162
N77-11794
DA-ARO(D)-31-124-73-G31
N77-11787
DA-ERO-75-G-029
N77-11141
DAAA15-75-C-0083
N77-11464
N77-11479
N77-11480
DAAA21-76-C-0025
N77-11791
DAAB07-72-C-0259
N77-11688
DAAB07-74-C-0606
N77-11315
DAAB07-75-C-0044
N77-11822
DAAB07-75-C-0045
N77-11309
DAAE07-75-C-0066
N77-11416
DAAG46-74-C-0140
N77-11128
DAAG46-75-C-0054
N77-11171
DAAG46-75-C-0091
N77-11126
DAAG53-75-C-0249
N77-11182
DAAG53-75-F-0918
N77-11729
DAAH01-74-C-0417
N77-11027
DAAH01-74-C-0624
N77-11317
DAAJ02-73-C-0097
N77-11041
DAAK02-74-C-0102
N77-11889
DADA17-71-C-1104
N77-11657
DAHC04-74-G-0153
N77-11774
DAHC04-75-G-0037
N77-11733
DAHC04-75-G-0150
N77-11777
DAHC04-76-G-0010
N77-11773
N77-11794
DAHC15-73-C-0181
N77-11355
DI-BM-HO-357078
N77-11380
DI-14-01-0001-1664
N77-11557
N77-11558
N77-11559
DI-14-03-6101N
N77-11552
DI-14-06-D-7052
N77-11514
DI-14-31-0001-4021
N77-11593
DI-14-31-0001-4157
N77-11387
DI-14-31-0001-5022
N77-11510
DI-14-31-0001-5032
N77-11921
DNA PROJ. NWED-QAXHD028
N77-11629
DNA PROJ. NWED-QAXPP001
N77-11866
DNA001-73-C-0177
N77-11866
DOT-FA72WA-2823
N77-11818
DOT-FA72WA-2837
N77-11024
DOT-FA72WA-3099
N77-11045
DOT-FA74WA-3539
N77-11821
DOT-FA75WAI-531
N77-11437

DOI-PH-11-8122 N77-11468
DOT-PS-40346 N77-11021
DOT-TSC-988 N77-11002
DRME-74/024 N77-11639
DRME-75/057 N77-11375
E(11-1)-2699 N77-11538
E(11-1)-3077 N77-11764
E(30-1)-16 N77-11539
E(33-1)-GEN-53 N77-11419
E(36-1)-GEN-14 N77-11444
E(49-18)-390 N77-11535
E(49-18)-1173 N77-11202
EDA-PP-487 N77-11274
EPA-R-802396 N77-11591
EPA-R-802946 N77-11642
EPA-68-01-1981 N77-11549
EPA-68-01-2634 N77-11933
EPA-68-01-2940 N77-11602
EPA-68-01-2951 N77-11513
EPA-68-01-2971 N77-11928
EPA-68-02-1081 N77-11605
EPA-68-02-1319 N77-11574
EPA-68-02-1412 N77-11581
EPA-68-02-1480 N77-11597
EPA-68-02-1749 N77-11384
EPA-68-02-2110 N77-11585
EPA-68-02-2114 N77-11596
EPA-68-02-2315 N77-11589
EPA-68-03-0443 N77-11595
EPA-68-03-2172 N77-11603
EPRI PROJ. 572-2 N77-11599
ERDA-75-S-134 N77-11551
ESA-SC/97-HQ N77-11088 N77-11089
ESTEC-1852/73-AA N77-11407
ESTEC-2474/75-MD N77-11407
FEA-CA-04-50055-00 N77-11555
FEA-CA-05-50078-00 N77-11516
FEA-CO-03-50222-00 N77-11515
FWPCA-WA-11-0003 N77-11923
F04611-73-C-0025 N77-11109
F04695-67-C-0197 N77-11857
F04701-75-C-0076 N77-11139 N77-11395 N77-11833 N77-11966
F19628-73-C-0282 N77-11858
F19628-73-C-0300 N77-11629
F19628-74-C-0083 N77-11728
F19628-74-C-0110 N77-11939
F19628-75-C-0044 N77-11621
F19628-75-C-0104 N77-11632
F19628-76-C-0001 N77-11569 N77-11751
F19628-76-C-0002 N77-11314 N77-11856
F19628-76-C-0089 N77-11628
F29601-74-C-0046 N77-11129
F30602-71-C-0312 N77-11732
F30602-72-C-0042 N77-11524
F30602-72-C-0249 N77-11731
F30602-74-C-0001 N77-11311
F30602-74-C-0242 N77-11278
F30602-74-C-0296 N77-11699
F30602-74-C-0304 N77-11308
F30602-74-C-0335 N77-11749 N77-11750
F30602-75-C-0042 N77-11730
F30602-75-C-0051 N77-11282
F30602-75-C-0122 N77-11316
F30602-75-C-0228 N77-11700
F30602-76-C-0029 N77-11698
F33615-71-C-1420 N77-11834
F33615-71-C-1574 N77-11127
F33615-71-C-1739 N77-11680
F33615-72-C-0235 N77-11686
F33615-72-C-1078 N77-11058
F33615-72-C-1213 N77-11796
F33615-72-C-1641 N77-11183
F33615-72-C-1757 N77-11160
F33615-73-C-4307 N77-11520
F33615-74-C-2069 N77-11062
F33615-74-C-3046 N77-11042
F33615-74-C-4005 N77-11689
F33615-75-C-2008 N77-11408
F33615-75-C-2023 N77-11140
F33615-75-C-3036 N77-11035
F44620-70-C-0105 N77-11687
F44620-71-C-0024 N77-11656
F44620-71-C-0080 N77-11013
F44620-71-C-0110 N77-11771
F44620-73-C-0011 N77-11023
F44620-73-C-0074 N77-11759
F44620-74-C-0044 N77-11166
F44620-74-C-0076 N77-11855
F44620-75-C-0039 N77-11854
GM-01090-14 N77-11655
HDL PROJ. 304634 N77-11388
H0232039 N77-11681
JPL-954444 N77-11199
MR0410101 N77-11659
NASA ORDER H-92100A N77-11367
NASA ORDER L-88328 N77-11569
NASA ORDER S-54114 N77-11497
NASA ORDER W-13183 N77-11075 N77-11076 N77-11954
NASA ORDER W-13557 N77-11503
NASW-2482 N77-11937
NASW-2485 N77-11616
NASW-2743 N77-11892
NASW-2791 N77-11093 N77-11117 N77-11615 N77-11670
NASW-2792 N77-10997 N77-11009 N77-11019 N77-11029 N77-11528 N77-11614 N77-11785 N77-11786 N77-11946 N77-11951
NASW-2895 N77-11508
NASW-2911 N77-11914
NASW-2970 N77-11399
NAS1-9559 N77-11068
NAS1-11100 N77-11032
NAS1-12794 N77-11345
NAS1-13158 N77-11006
NAS1-13653 N77-11030
NAS1-13709 N77-11034
NAS1-13732 N77-11005
NAS1-13908 N77-11667
NAS1-14337 N77-11211
NAS2-8239 N77-11676
NAS2-8582 N77-11054
NAS2-8644 N77-11677
NAS2-8663 N77-11107
NAS2-8732 N77-11672
NAS2-9026 N77-11673
NAS2-9177 N77-11064
NAS3-16742 N77-11531
NAS3-16766 N77-11114 N77-11115 N77-11116
NAS3-17846 N77-11048 N77-11049
NAS3-18024 N77-11046 N77-11047
NAS3-18920 N77-11154
NAS5-20985 N77-11485
NAS5-22495 N77-11086
NAS7-100 N77-11197 N77-11198 N77-11199 N77-11269 N77-11354 N77-11363 N77-11398 N77-11717 N77-11763
NAS8-21270 N77-11174
NAS8-21810 N77-11003
NAS8-28358 N77-11096 N77-11755
NAS8-30631 N77-11916
NAS8-31194 N77-11617
NAS8-31440 N77-11092
NAS8-31538 N77-11081
NAS8-31625 N77-11212
NAS9-12200 N77-11091 N77-11505
NAS9-13247 N77-11000 N77-11090
NAS9-14217 N77-11671
NAS9-14345 N77-11532
NAS9-14958 N77-11083 N77-11084 N77-11085
NAS9-14960 N77-11077 N77-11078
NGL-11-002-096 N77-11440
NGL-44-084-003 N77-11502
NGR-05-020-559 N77-11624 N77-11948 N77-11955 N77-11956
NGR-05-020-634 N77-11915
NGR-21-002-316 N77-11935
NIVR-1737 N77-11011
NR PROJ. 017-653 N77-11159 N77-11887
NR PROJ. 031-781 N77-11163
NR PROJ. 032-542 N77-11184
NR PROJ. 041-434 N77-11467 N77-11776
NR PROJ. 042-282 N77-11768
NR PROJ. 042-295 N77-11788
NR PROJ. 042-296 N77-11797
NR PROJ. 044-402 N77-11790
NR PROJ. 044-457 N77-11772
NR PROJ. 047-033 N77-11741
NR PROJ. 047-048 N77-11806
NR PROJ. 049-272 N77-11905
NR PROJ. 049-360 N77-11904
NR PROJ. 056-596 N77-11888
NR PROJ. 078-038 N77-11059
NR PROJ. 083-364 N77-11467 N77-11776
NR PROJ. 083-603 N77-11517
NR PROJ. 151-370 N77-11897 N77-11898 N77-11899
NR PROJ. 197-022 N77-11685
NR PROJ. 215-229 N77-11683
NR PROJ. 215-233 N77-11017
NR PROJ. 229-016 N77-11178
NR PROJ. 347-020 N77-11798
NRL PROJ. G04-01A N77-11643
NRL PROJ. R01-62 N77-11748
NRL PROJ. R01-87 N77-11736
NRL PROJ. S01-29 N77-11742
NR042295 N77-11789
NSF AER-74-13292 N77-11548
NSF AER-74-17940-A01 N77-11577
NSF AER-75-1679 N77-11547
NSF AER-75-13673 N77-11511
NSF AER-76-09748 N77-11544
NSF APR-74-15256 N77-11215
NSF ATA-74-22962 N77-11473

NSF ATM-74-19007 N77-11624
N77-11948
N77-11955
N77-11956
NSF DCR-72-01206-A05 N77-11747
NSF DCR-72-03752 N77-11790
NSF DES-75-15664 N77-11624
N77-11955
N77-11956
NSF ENG-75-10225 N77-11777
NSF GI-32724 N77-11545
NSF GI-41470 N77-11544
NSF GI-43895 N77-11551
NSF GK-35305 N77-11452
NSF GK-37072 N77-11452
NSF GK-42132 N77-11679
NSF MPS-73-08534-A02 N77-11806
NSF MPS-75-05769 N77-11543
NSF PRA-75-04134 N77-11926
NSG-268 N77-11365
NSG-1149 N77-11486
NSG-2064 N77-11340
NSG-3091 N77-11389
NSG-7142 N77-11362
NSG-7144 N77-11267
NUSC PROJ. A-700-11 N77-11820
N00014-67-A-0112-0044 N77-11697
N00014-67-A-0181-0051 N77-11685
N00014-67-A-0216-0007 N77-11905
N00014-68-A-0173-0021 N77-11421
N77-11422
N00014-68-A-0410-0004 N77-11772
N00014-70-A-0362-0001 N77-11790
N00014-70-C-0390 N77-11164
N00014-73-A-0434-0002 N77-11795
N00014-73-C-0401 N77-11184
N00014-74-A-0436-0001 N77-11897
N77-11898
N77-11899
N00014-74-C-0076 N77-11683
N00014-74-C-0151 N77-11017
N00014-75-C-0052 N77-11393
N00014-75-C-0055 N77-11207
N00014-75-C-0209 N77-11517
N00014-75-C-0388 N77-11178
N00014-75-C-0405 N77-11313
N00014-75-C-0419 N77-11460
N00014-75-C-0440 N77-11904
N00014-75-C-0443 N77-11768
N00014-75-C-0453 N77-11770
N00014-75-C-0492 N77-11797
N00014-75-C-0499 N77-11138
N00014-75-C-0518 N77-11757
N00014-75-C-0621 N77-11806
N00014-75-C-0643 N77-11727
N00014-75-C-0661 N77-11727
N00014-75-C-0729 N77-11798
N00014-75-C-0779 N77-11795
N00014-75-C-0783 N77-11421
N77-11422
N00014-75-C-0838 N77-11778
N00014-75-C-0889 N77-11163
N00014-75-C-0970 N77-11888
N00014-75-C-0980 N77-11893
N00014-75-C-1003 N77-11788
N77-11789
N00014-75-C-1143 N77-11059
N00014-76-C-0039 N77-11467
N77-11776
N00014-76-C-0050 N77-11159
N77-11887
N00014-76-C-0079 N77-11467
N77-11776
N00014-76-C-0134 N77-11741
N00014-76-C-0200 N77-11180
N00014-76-C-0207 N77-11624
N77-11948
N77-11955
N77-11956
N00017-72-C-4401 N77-11351
N77-11769
N00019-74-C-0409 N77-11162
N00019-75-C-0113 N77-11124
N00024-72-C-1277 N77-11420
N00156-70-C-1321 N77-11036
N00228-75-C-2362 N77-11622
N62269-74-C-0300 N77-11161
N62269-75-C-0129 N77-11165
N62269-75-C-0311 N77-11065
OSURF PROJ. 3641 N77-11060
OSURF PROJ. 3656-A N77-11664
PASA-TA(CE)-5-71 N77-11214
PROJ. SQUID N77-11059
RF21222404 N77-11736
RF55522002 N77-11758
RR0210501 N77-11795
RR0420402 N77-11897
N77-11898
N77-11899
RR0420601 N77-11778
RR1310341 N77-11742
SP11121702 N77-11820
SP43422502 N77-11474
SP43432702O8 N77-11409
SR0140301 N77-11735
SR0240201 N77-11643
STAE-73/93409 N77-11819
STAE-74/98018 N77-11370
T/R-780/R-7800/41088 N77-11392
UMTA-CA-11-0008 N77-11696
UMTA-HA-11-0024 N77-11922
UMTA-VA-11-0003 N77-11924
W-7405-ENG-26 N77-11534
N77-11571
N77-11720
N77-11765
W-7405-ENG-36 N77-11694
W-7405-ENG-48 N77-11157
N77-11203
N77-11572
N77-11722
N77-11767
N77-11831
N77-11909
W-7405-ENG-82 N77-11541
WF41422206 N77-11036
YF53534011 N77-11312
ZF61512001 N77-11413
170-48-52 N77-11830
175-10-40 N77-11294
199-73-01-05-72 N77-11675
504-09-32 N77-11674
504-09-33 N77-11044
504-09-42 N77-11693
505-01 N77-11118
N77-11155
505-03 N77-11056
505-03-11-02 N77-11816
505-04 N77-11004
N77-11007
N77-11008
N77-11366
N77-11400
N77-11401
N77-11402
505-04-11-01 N77-11069
505-05 N77-11057
505-06-11-03 N77-11342
505-06-13-01-00-21 N77-11343
505-07-22-01 N77-11266
505-08-30-01 N77-11001
505-09-21-01 N77-11666
505-10-11-01 N77-11033
505-10-21 N77-11390
505-10-21-01 N77-11345
505-11-15-02 N77-11339
505-11-24-02 N77-10998
505-11-31-02 N77-11346
505-11-41-16 N77-10995
506-17 N77-11442
506-23 N77-11175
506-25 N77-11213
506-25-99-00 N77-11099
506-26-30-01 N77-11087
510-56-01 N77-11111
513-50-50-01 N77-11667
513-53-02 N77-11063
610-22 N77-11268
N77-11295
644-04 N77-11908
743-04-01-01 N77-11031

REPORT/ACCESSION NUMBER INDEX

Typical Report/Accession Number Index Listing



Listings in this index are arranged alphanumerically by report number. The NASA accession number denotes the number by which the citation is identified. An asterick (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche. Accession numbers followed by a plus sign (+) are not available on microfiche because of size or reproducibility.

A-76-11 ..... N77-11362*#
A-6278 ..... N77-11343*#
A-6546 ..... N77-11693*#
A-6630 ..... N77-11674*#
A-6633 ..... N77-11111*#
A-6663 ..... N77-11044*#
A-6693 ..... N77-11063*#
A-6765 ..... N77-11390*#

AD-A022715 ..... N77-11351 #
AD-A023143 ..... N77-11178 #
AD-A023655 ..... N77-11463 #
AD-A023668 ..... N77-11124 #
AD-A023669 ..... N77-11688 #
AD-A023675 ..... N77-11626 #
AD-A023677 ..... N77-11662 #
AD-A023678 ..... N77-11179 #
AD-A023681 ..... N77-11023 #
AD-A023690 ..... N77-11037 #
AD-A023691 ..... N77-11661 #
AD-A023693 ..... N77-11772 #
AD-A023715 ..... N77-11637 #
AD-A023716 ..... N77-11770 #
AD-A023720 ..... N77-11620 #
AD-A023728 ..... N77-11684 #
AD-A023755 ..... N77-11015 #
AD-A023758 ..... N77-11415 #
AD-A023763 ..... N77-11208 #
AD-A023766 ..... N77-11771 #
AD-A023767 ..... N77-11036 #
AD-A023771 ..... N77-11125 #
AD-A023774 ..... N77-11181 #
AD-A023775 ..... N77-11277 #
AD-A023781 ..... N77-11163 #
AD-A023784 ..... N77-11685 #
AD-A023787 ..... N77-11393 #
AD-A023789 ..... N77-11789 #
AD-A023817 ..... N77-11896 #
AD-A023818 ..... N77-11314 #
AD-A023821 ..... N77-11769 #
AD-A023822 ..... N77-11180 #
AD-A023829 ..... N77-11313 #
AD-A023832 ..... N77-11164 #
AD-A023837 ..... N77-11894 #
AD-A023843 ..... N77-11318 #
AD-A023844 ..... N77-11035 #
AD-A023849 ..... N77-11966 #
AD-A023854 ..... N77-11806 #
AD-A023861 ..... N77-11773 #
AD-A023862 ..... N77-11206 #
AD-A023866 ..... N77-11733 #
AD-A023872 ..... N77-11791 #
AD-A023874 ..... N77-11905 #
AD-A023875 ..... N77-11904 #
AD-A023886 ..... N77-11420 #
AD-A023888 ..... N77-11408 #
AD-A023889 ..... N77-11893 #
AD-A023894 ..... N77-11732 #
AD-A023896 ..... N77-11139 #
AD-A023906 ..... N77-11308 #
AD-A023908 ..... N77-11622 #
AD-A023910 ..... N77-11141 #
AD-A023913 ..... N77-11309 #
AD-A023919 ..... N77-11129 #
AD-A023928 ..... N77-11278 #
AD-A023931 ..... N77-11697 #
AD-A023935 ..... N77-11140 #
AD-A023941 ..... N77-11687 #
AD-A023944 ..... N77-11128 #
AD-A023946 ..... N77-11171 #
AD-A023950 ..... N77-11311 #
AD-A023955 ..... N77-11354*#
AD-A023968 ..... N77-11455 #
AD-A023973 ..... N77-11683 #
AD-A023975 ..... N77-11798 #
AD-A024004 ..... N77-11059 #
AD-A024012 ..... N77-11895 #
AD-A024017 ..... N77-11643 #
AD-A024019 ..... N77-11748 #
AD-A024024 ..... N77-11275 #
AD-A024025 ..... N77-11625 #
AD-A024027 ..... N77-11700 #
AD-A024036 ..... N77-11658 #
AD-A024037 ..... N77-11353 #
AD-A024042 ..... N77-11927 #
AD-A024050 ..... N77-11458 #
AD-A024051 ..... N77-11461 #
AD-A024054 ..... N77-11312 #
AD-A024058 ..... N77-11409 #
AD-A024064 ..... N77-11460 #
AD-A024068 ..... N77-11699 #
AD-A024071 ..... N77-11038 #
AD-A024072 ..... N77-11040 #
AD-A024073 ..... N77-11016 #
AD-A024074 ..... N77-11310 #
AD-A024082 ..... N77-11787 #
AD-A024099 ..... N77-11686 #
AD-A024100 ..... N77-11680 #
AD-A024131 ..... N77-11897 #
AD-A024132 ..... N77-11898 #
AD-A024133 ..... N77-11899 #
AD-A024137 ..... N77-11788 #
AD-A024147 ..... N77-11138*#
AD-A024149 ..... N77-11727 #
AD-A024155 ..... N77-11832 #
AD-A024156 ..... N77-11938 #
AD-A024158 ..... N77-11775 #
AD-A024159 ..... N77-11142 #
AD-A024161 ..... N77-11013 #
AD-A024162 ..... N77-11416 #
AD-A024196 ..... N77-11126 #
AD-A024203 ..... N77-11628 #
AD-A024208 ..... N77-11834 #
AD-A024213 ..... N77-11660 #
AD-A024217 ..... N77-11162 #
AD-A024225 ..... N77-11219 #
AD-A024252 ..... N77-11758 #
AD-A024255 ..... N77-11794 #
AD-A024256 ..... N77-11422 #
AD-A024257 ..... N77-11421 #
AD-A024258 ..... N77-11833 #
AD-A024273 ..... N77-11757 #
AD-A024275 ..... N77-11412 #
AD-A024286 ..... N77-11689 #
AD-A024290 ..... N77-11013 #
AD-A024300 ..... N77-11656 #
AD-A024303 ..... N77-11582 #
AD-A024306 ..... N77-11413 #
AD-A024309 ..... N77-11629 #
AD-A024312 ..... N77-11659 #
AD-A024313 ..... N77-11731 #
AD-A024316 ..... N77-11061 #
AD-A024325 ..... N77-11797 #
AD-A024335 ..... N77-11728 #
AD-A024342 ..... N77-11166 #
AD-A024343 ..... N77-11060 #
AD-A024349 ..... N77-11888 #

AD-A024354 ..... N77-11317 #
AD-A024355 ..... N77-11627 #
AD-A024379 ..... N77-11385 #
AD-A024380 ..... N77-11750 #
AD-A024383 ..... N77-11682 #
AD-A024386 ..... N77-11887 #
AD-A024387 ..... N77-11159 #
AD-A024392 ..... N77-11749 #
AD-A024394 ..... N77-11316 #
AD-A024395 ..... N77-11730 #
AD-A024396 ..... N77-11698 #
AD-A024408 ..... N77-11621 #
AD-A024413 ..... N77-11793 #
AD-A024416 ..... N77-11790 #
AD-A024418 ..... N77-11414 #
AD-A024420 ..... N77-11165 #
AD-A024425 ..... N77-11160 #
AD-A024437 ..... N77-11768 #
AD-A024440 ..... N77-11623 #
AD-A024446 ..... N77-11058 #
AD-A024447 ..... N77-11022 #
AD-A024465 ..... N77-11411 #
AD-A024470 ..... N77-11315 #
AD-A024472 ..... N77-11410 #
AD-A024481 ..... N77-11774 #
AD-A024484 ..... N77-11729 #
AD-A024487 ..... N77-11065 #
AD-A024501 ..... N77-11039 #
AD-A024507 ..... N77-11465 #
AD-A024510 ..... N77-11220 #
AD-A024512 ..... N77-11066 #
AD-A024518 ..... N77-11792 #
AD-A024520 ..... N77-11352 #
AD-A024537 ..... N77-11127 #
AD-A024540 ..... N77-11161 #
AD-A024549 ..... N77-11456 #
AD-A024552 ..... N77-11734 #
AD-A024553 ..... N77-11098 #
AD-A024591 ..... N77-11464 #
AD-A024600 ..... N77-11902 #
AD-A024602 ..... N77-11948*#
AD-A024603 ..... N77-11624*#
AD-A024604 ..... N77-11956*#
AD-A024605 ..... N77-11955*#
AD-A024633 ..... N77-11657 #
AD-A024643 ..... N77-11663 #
AD-A024652 ..... N77-11207 #
AD-A024653 ..... N77-11854 #
AD-A024744 ..... N77-11026 #
AD-A024975 ..... N77-11855 #
AD-A024980 ..... N77-11018 #
AD-A025070 ..... N77-11701 #
AD-A025074 ..... N77-11759 #
AD-A025076 ..... N77-11517 #
AD-A025077 ..... N77-11778 #
AD-A025078 ..... N77-11795 #
AD-A025081 ..... N77-11736 #
AD-A025083 ..... N77-11043 #
AD-A025089 ..... N77-11280 #
AD-A025090 ..... N77-11281 #
AD-A025096 ..... N77-11172 #
AD-A025098 ..... N77-11664 #
AD-A025210 ..... N77-11742 #
AD-A025217 ..... N77-11474 #
AD-A025220 ..... N77-11027 #
AD-A025224 ..... N77-11858 #
AD-A025256 ..... N77-11183 #
AD-A025258 ..... N77-11184 #
AD-A025259 ..... N77-11282 #
AD-A025261 ..... N77-11109 #
AD-A025265 ..... N77-11041 #
AD-A025266 ..... N77-11042 #
AD-A025268 ..... N77-11395 #
AD-A025270 ..... N77-11751 #
AD-A025273 ..... N77-11939 #
AD-A025279 ..... N77-11820 #
AD-A025289 ..... N77-11777 #
AD-A025290 ..... N77-11017 #
AD-A025292 ..... N77-11735 #
AD-A025294 ..... N77-11889 #
AD-A025296 ..... N77-11467 #
AD-A025297 ..... N77-11776 #
AD-A025337 ..... N77-11355 #
AD-A025338 ..... N77-11856 #
AD-A025340 ..... N77-11857 #
AD-A025420 ..... N77-11404*#
AD-A025421 ..... N77-11631 #
AD-A025428 ..... N77-11524 #
AD-A025429 ..... N77-11283 #

AD-A025466 ..... N77-11388 #
AD-A025472 ..... N77-11417 #
AD-A025490 ..... N77-11632 #
AD-A025491 ..... N77-11356 #
AD-A025492 ..... N77-11822 #
AD-A025498 ..... N77-11866 #
AD-A025499 ..... N77-11478 #
AD-A025500 ..... N77-11062 #
AD-A025501 ..... N77-11028 #
AD-A025502 ..... N77-11479 #
AD-A025503 ..... N77-11480 #
AD-A025505 ..... N77-11702 #
AD-A025595 ..... N77-11182 #
AD-A025605 ..... N77-11740 #
AD-A025616 ..... N77-11519 #
AD-A025624 ..... N77-11796 #
AD-A025715 ..... N77-11741 #
AD-A025773 ..... N77-11520 #
AD-A025856 ..... N77-11779 #
AD-A028094/1 ..... N77-11437 #
AD-A028511/4 ..... N77-11821 #
AD-A028512/2 ..... N77-11818 #
AD-A028513/0 ..... N77-11024 #
AD-A028514/8 ..... N77-11025 #
AD-A028765/6 ..... N77-11045 #
AD-A029049/4 ..... N77-11002 #

AECL-5260 ..... N77-11156 #
AECL-5262 ..... N77-11723 #
AECL-5311 ..... N77-11137 #
AECL-5314 ..... N77-11533 #

AEDC-TR-76-18 ..... N77-11015 #
AEDC-TR-76-22 ..... N77-11037 #
AEDC-TR-76-28 ..... N77-11098 #

AERO-1214 ..... N77-11356 #

AFAPL-TR-75-75 ..... N77-11408 #
AFAPL-TR-75-99 ..... N77-11140 #
AFAPL-TR-75-108 ..... N77-11062 #
AFAPL-TR-75-111 ..... N77-11318 #
AFAPL-TR-76-4 ..... N77-11058 #

AFCRL-PSRP-654 ..... N77-11832 #

AFCRL-TR-75-0509 ..... N77-11629 #
AFCRL-TR-75-0624 ..... N77-11858 #
AFCRL-TR-76-0023 ..... N77-11832 #
AFCRL-TR-76-0033 ..... N77-11632 #

AFFDL-TR-75-32 ..... N77-11478 #
AFFDL-TR-75-123 ..... N77-11042 #
AFFDL-TR-75-145 ..... N77-11796 #
AFFDL-TR-75-162 ..... N77-11035 #
AFFDL-TR-76-43 ..... N77-11028 #

AFGL-AFSG-338 ..... N77-11938 #

AFGL-ERP-551 ..... N77-11626 #
AFGL-ERP-552 ..... N77-11775 #

AFGL-TR-76-0015 ..... N77-11938 #
AFGL-TR-76-0034 ..... N77-11626 #
AFGL-TR-76-0035 ..... N77-11775 #
AFGL-TR-76-0057 ..... N77-11621 #
AFGL-TR-76-0072 ..... N77-11939 #
AFGL-TR-76-0073 ..... N77-11628 #
AFGL-TR-76-0081 ..... N77-11620 #

AFML-TR-74-73-PT-2 ..... N77-11183 #
AFML-TR-75-33 ..... N77-11127 #
AFML-TR-75-198 ..... N77-11834 #

AFOSR-75-1704TR ..... N77-11766 #
AFOSR-76-0189TR ..... N77-11771 #
AFOSR-76-0275TR ..... N77-11463 #
AFOSR-76-0321TR ..... N77-11166 #
AFOSR-76-0436TR ..... N77-11854 #
AFOSR-76-0454TR ..... N77-11774 #
AFOSR-76-0457TR ..... N77-11656 #
AFOSR-76-0476TR ..... N77-11687 #
AFOSR-76-0481TR ..... N77-11013 #
AFOSR-76-0501TR ..... N77-11412 #
AFOSR-76-0503TR ..... N77-11060 #
AFOSR-76-0505TR ..... N77-11061 #
AFOSR-76-0522TR ..... N77-11793 #
AFOSR-76-0543TR ..... N77-11855 #
AFOSR-76-0545TR ..... N77-11664 #

AFOSR-76-0550TR ..... N77-11172 #
AFOSR-76-0602TR ..... N77-11759 #

AFRPL-TR-76-11 ..... N77-11109 #

AFWL-TR-74-330 ..... N77-11129 #

AGARD-AG-216 ..... N77-11907 #

AGARD-AR-98 ..... N77-11357 #

AGARD-CP-189 ..... N77-11644 #
AGARD-CP-193 ..... N77-11221 #
AGARD-CP-194 ..... N77-11185 #

AGARD-R-644 ..... N77-11070 #

AIRESEARCH-73-311305-VOL-1 ..... N77-11046*#
AIRESEARCH-73-311305-VOL-2 ..... N77-11047*#
AIRESEARCH-74-310862-VOL-1 ..... N77-11048*#
AIRESEARCH-74-310862-VOL-2 ..... N77-11049*#
AIRESEARCH-76-211893 ..... N77-11054*#

AMMRC-CR-76-4 ..... N77-11128 #

AMMRC-CTR-76-6 ..... N77-11171 #
AMMRC-CTR-76-7 ..... N77-11126 #

AMRC-1624 ..... N77-11167 #

AMRL-HESS-74-4 ...\..... N77-11689 #

AMRL-TR-75-1 ..... N77-11520 #
AMRL-TR-75-91 ..... N77-11680 #
AMRL-TR-75-95 ..... N77-11686 #
AMRL-TR-75-116 ..... N77-11689 #
AMRL-TR-75-124 ..... N77-11043 #

AMSAA-TR-162 ..... N77-11779 #

ANL/HEP/PR-76-11 ..... N77-11719 #

APL-JHU-TG-1285 ..... N77-11351 #

APL/JHU-POR-3117 ..... N77-11769 #

ARB-R-4-051-76-49 ..... N77-11578 #

ARL-TR-75-0218 ..... N77-11354*#
ARL-TR-75-0235 ..... N77-11160 #

ARL-75-21/AFOSR-75-10 ..... N77-11687 #

ARO-PWT-TR-75-80 ..... N77-11037 #

ARO-VKF-TR-75-164 ..... N77-11015 #
ARO-VKF-TR-75-165 ..... N77-11098 #

ARO-10913.14-M ..... N77-11787 #
ARO-12640.4-M ..... N77-11777 #

ART-4-250 ..... N77-11578 #

ASD/RAXA-76-5 ..... N77-11894 #

ASI-TR-75-26 ..... N77-11030*#

ASRL-TR-179-1 ..... N77-11042 #

BHPRD-76/2 ..... N77-11903 #

BM-OFR-73-76 ..... N77-11681 #
BM-OFR-77-76 ..... N77-11380 #

BM-RI-8147 ..... N77-11167 #
BM-RI-8151 ..... N77-11518 #
BM-RI-8153 ..... N77-11386 #

BMFT-FB-T-76-02 ..... N77-11298 #
BMFT-FB-T-76-05 ..... N77-11270 #
BMFT-FB-T-76-06 ..... N77-11299 #
BMFT-FB-T-76-07 ..... N77-11350 #
BMFT-FB-T-76-09 ..... N77-11300 #
BMFT-FB-T-76-10 ..... N77-11301 #
BMFT-FB-T-76-11 ..... N77-11302 #
BMFT-FB-T-76-14 ..... N77-11303 #
BMFT-FB-T-76-15 ..... N77-11304 #
BMFT-FB-T-76-16 ..... N77-11305 #
BMFT-FB-T-76-17 ..... N77-11377 #

BMFT-FB-T-76-20 ..... N77-11306 #
BMFT-FB-T-76-21 ..... N77-11307 #

BMFT-FB-76-19 ..... N77-11177 #

BMFT-NT-289 ..... N77-11299 #
BMFT-NT-581 ..... N77-11270 #
BMFT-NT-0228 ..... N77-11298 #

BNL-20931 ..... N77-11201 #
BNL-50493 ..... N77-11539 #

BRL-MR-2618 ..... N77-11018 #

BRL-1866-PT-2 ..... N77-11016 #
BRL-8031 ..... N77-11524 #

BW-TR-576 ..... N77-11315 #

CA-DOT-TL-3317-1-76-19 ..... N77-11454 #
CA-DOT-TL-3476-2-75-44 ..... N77-11457 #
CA-DOT-TL-5182-1-75-22 ..... N77-11472 #

CE-TR-205 ..... N77-11577 #

CEL-TN-1431 ..... N77-11461 #
CEL-TN-1434 ..... N77-11458 #

CEL-TR-839 ..... N77-11312 #

CERF AP-18 ..... N77-11437 #

CERL-TR-E-76 ..... N77-11582 #

CMD-03-76 ..... N77-11414 #

CN-ISSN-0082-5263 ..... N77-11438 #

CONF-751176-1 ..... N77-11909 #
CONF-760421-1 ..... N77-11884 #
CONF-760702-1 ..... N77-11694 #
CONF-7509116-1 ..... N77-11157 #
CONF-7509125-1 ..... N77-11541 #

COO-2617-75/1 ..... N77-11536 #
COO-2699-3 ..... N77-11538 #
COO-3077-106 ..... N77-11764 #

CS-76-026 ..... N77-11772 #

CSS-76-3 ..... N77-11893 #

CSU-FNR-7052-1 ..... N77-11514 #

C75-1443/034C ..... N77-11035 #

DADELTA-1/1 ..... N77-11494*#

DARCOM-ITC-02-08-76-006 ..... N77-11026 #

DDC/BIB-76/02 ..... N77-11902 #

DLR-IB-151-75/14 ..... N77-11073 #
DLR-IB-151-76/1 ..... N77-11074 #
DLR-IB-552-74/5 ..... N77-11094 #

DME-ME-242 ..... N77-11411 #

DMS-DR-2325 ..... N77-11000*#
DMS-DR-2334 ..... N77-11090*#

DN-1.4-8-015 ..... N77-11077*#
DN-1.4-9-01 ..... N77-11078*#

DNA-3597F ..... N77-11866 #

DOD-AGFSRS-76-3 ..... N77-11022 #

DOT-TPI-76-1-VOL-2 ..... N77-11021 #

DOT-TSC-FAA-76-15 ..... N77-11002 #

DTNSEDC-76-0037 ..... N77-11413 #
DTNSRDC-76-0085 ..... N77-11735 #
DTNSRDC-4766 ..... N77-11220 #
DTNSRDC-4799 ..... N77-11474 #

DTNSRDC/ASED/1216 ..... N77-11220 #

D3-11015-1 ..... N77-11667*#
D6-43798-2 ..... N77-11005*#
D180-20216-1 ..... N77-11064*#

E-8174 ..... N77-11175*#
E-8560 ..... N77-11057*#
E-8571 ..... N77-11008*#
E-8579 ..... N77-11004*#
E-8648 ..... N77-11118*#
E-8657 ..... N77-11442*#
E-8699 ..... N77-11817*#
E-8712 ..... N77-11400*#
E-8718 ..... N77-11056*#
E-8720 ..... N77-11007*#
E-8750 ..... N77-11155*#
E-8777 ..... N77-11295*#
E-8780 ..... N77-11213*#
E-8796 ..... N77-11908*#
E-8816 ..... N77-11366*#
E-8817 ..... N77-11401*#
E-8832 ..... N77-11268*#
E-8892 ..... N77-11439*#
E-8895 ..... N77-11100*#
E-8896 ..... N77-11529*#
E-8905 ..... N77-11402*#
E-8919 ..... N77-11655*#
E-8932 ..... N77-11530*#
E-8933 ..... N77-11389*#
E-8935 ..... N77-11901*#
E-8937 ..... N77-11101*#
E-8942 ..... N77-11102*#
E-8945 ..... N77-11612*#
E-8947 ..... N77-11718*#
E-8949 ..... N77-11815*#
E-8952 ..... N77-11103*#
E-8957 ..... N77-11104*#
E-8961 ..... N77-11053*#
E-8966 ..... N77-11105*#
E-8972 ..... N77-11050*#
E-8974 ..... N77-11051*#
E-8992 ..... N77-11106*#
E-8995 ..... N77-11052*#

ECOM-4396 ..... N77-11310 #
ECOM-4398 ..... N77-11275 #
ECOM-4407 ..... N77-11280 #

EDA/OER-76-004 ..... N77-11274 #

EDC-76-1 ..... N77-11412 #

EM-CR-76029 ..... N77-11479 #
EM-CR-76030 ..... N77-11480 #
EM-CR-76031 ..... N77-11464 #

EMEP-76-7 ..... N77-11281 #

EOARD-TR-76-002 ..... N77-11352 #

EPA-SW-123C ..... N77-11513 #

EPA-330/2-76-019 ..... N77-11586 #
EPA-330/2-76-021 ..... N77-11594 #
EPA-330/2-76-024 ..... N77-11587 #
EPA-450/4-75-002 ..... N77-11606 #
EPA-460/3-76-014 ..... N77-11603 #
EPA-520/1-76-010 ..... N77-11636 #
EPA-600/1-76-024 ..... N77-11576 #
EPA-600/2-76-021 ..... N77-11591 #
EPA-600/2-76-062 ..... N77-11384 #
EPA-600/2-76-089-A ..... N77-11585 #
EPA-600/2-76-092 ..... N77-11574 #
EPA-600/2-76-093-B ..... N77-11581 #
EPA-600/2-76-141 ..... N77-11596 #
EPA-600/2-76-163 ..... N77-11642 #
EPA-600/2-76-164 ..... N77-11597 #
EPA-600/4-76-017 ..... N77-11584 #
EPA-600/4-76-018 ..... N77-11595 #
EPA-600/4-76-028 ..... N77-11601 #
EPA-600/4-76-032 ..... N77-11605 #
EPA-600/5-76-002 ..... N77-11933 #
EPA-600/7-76-001 ..... N77-11549 #
EPA-600/9-76-022 ..... N77-11602 #
EPA-903/9-75-022 ..... N77-11592 #

EPRI-EC-144 ..... N77-11599 #
EPRI-EC-184 ..... N77-11590 #

EPRI-EM-181 ..... N77-11130 #

EPRI-FP-164 ..... N77-11563 #

EPRI-NP-194 ..... N77-11550 #

EPRI-SR-45 ..... N77-11561 #

EPRI-262-VOL-2 ..... N77-11607 #

ERDA-SNS-3063-8 ..... N77-11108 #

ERDA-23A ..... N77-11540 #

ESA-CR(P)-830 ..... N77-11407 #
ESA-CR(P)-836-VOL-2 ..... N77-11088 #
ESA-CR(P)-836-VOL-3 ..... N77-11089 #

ESD-TR-75-364 ..... N77-11728 #
ESD-TR-76-34 ..... N77-11856 #
ESD-TR-76-61 ..... N77-11314 #
ESD-TR-76-139 ..... N77-11751 #

ESTL/TN/3 ..... N77-11407 #

ETL-0025 ..... N77-11729 #
ETL-0036 ..... N77-11627 #

E77-10005 ..... N77-11485*#
E77-10011 ..... N77-11486*#
E77-10024 ..... N77-11487*#
E77-10025 ..... N77-11488*#
E77-10026 ..... N77-11489*#
E77-10027 ..... N77-11490*#
E77-10028 ..... N77-11491*#
E77-10029 ..... N77-11492*#
E77-10030 ..... N77-11493*#
E77-10032 ..... N77-11494*#
E77-10034 ..... N77-11495*#
E77-10035 ..... N77-11496*#
E77-10036 ..... N77-11497*#
E77-10037 ..... N77-11498*#
E77-10039 ..... N77-11499*#
E77-10040 ..... N77-11500*#
E77-10041 ..... N77-11501*#

FA-TR-76021 ..... N77-11682 #

FAA-NA-75-46 ..... N77-11025 #

FAA-RD-73-145 ..... N77-11045 #
FAA-RD-75-125 ..... N77-11045 #
FAA-RD-75-216 ..... N77-11821 #
FAA-RD-76-66 ..... N77-11437 #
FAA-RD-76-87 ..... N77-11818 #
FAA-RD-76-94 ..... N77-11002 #
FAA-RD-76-98 ..... N77-11025 #
FAA-RD-76-117 ..... N77-11024 #

FCC/OCE/LAB-76-02-PT-1 ..... N77-11271 #
FCC/OCE/RS76-03 ..... N77-11273 #

FE-0390-1 ..... N77-11535 #
FE-1773-14 ..... N77-11202 #

FEA/B-76/218 ..... N77-11553 #
FEA/B-76/317 ..... N77-11515 #
FEA/D-76/318 ..... N77-11555 #
FEA/D-76/325 ..... N77-11554 #
FEA/EI-1664 ..... N77-11557 #
FEA/EI-1664-A ..... N77-11558 #
FEA/EI-1664-B ..... N77-11559 #
FEA/G-76/331 ..... N77-11546 #
FEA/H-76/220 ..... N77-11509 #

FES-76/1 ..... N77-11509 #

FHWA-AZ-RD-74(154) ..... N77-11470 #

FHWA-WHI-76-N001 ..... N77-11562 #

FHWA-RD-S0478 ..... N77-11476 #

FHWA-RD-76-S0481 ..... N77-11469 #
FHWA-RD-76-31 ..... N77-11468 #

FJSRL-TR-76-0006 ..... N77-11456 #
FJSRL-TR-76-0007 ..... N77-11014 #

FOA-C-10052-M3(E5) ..... N77-11738 #

FOK-R-1814 ..... N77-11120 #
FOK-R-1816 ..... N77-11405 #
FOK-R-1839 ..... N77-11448 #
FOK-R-1868 ..... N77-11121 #
FOK-R-1876 ..... N77-11122 #
FOK-R-1877 ..... N77-11123 #
FOK-R-1879 ..... N77-11449 #
FOK-R-1932 ..... N77-11176 #

FSEC-NSG-217-75/60 ..... N77-11108 #

FSRP-FRL-264 ..... N77-11465 #

FWS/OBS-76/05 ..... N77-11598 #

FY-76-9 ..... N77-11593 #

G-7T05J2 ..... N77-11830*#
G-76115 ..... N77-11294*#

GAC-19-1035 ..... N77-11182 #
GAC-2706-2876-22 ..... N77-11278 #

GPO-52-021 ..... N77-11910 #
GPO-75-984 ..... N77-11678 #

GS/PROD/MISC/116/75/C ..... N77-11453 #
GS/TECH/424/3/75/C ..... N77-11579 #
GS/TECH/703/1/75/C ..... N77-11737 #

GSA/FPA/MCL-TM-256 ..... N77-11739 #

GSFC/LN-76/006 ..... N77-11504*#
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GSFC/LN-76/008 ..... N77-11522*#
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GSFC/LU-76/006 ..... N77-11506*#
GSFC/LU-76/007 ..... N77-11507*#
GSFC/LU-76/008 ..... N77-11523*#
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HDL-TM-76-3 ..... N77-11388 #
HDL-TM-76-6 ..... N77-11701 #

HEDL-SA-1002 ..... N77-11884 #

HEL-TM-7-76 ..... N77-11684 #

HIG-DATA-30 ..... N77-11517 #

HIG-75-19 ..... N77-11517 #

ICAF-DOC-895 ..... N77-11441 #

IFC-TR-76-3 ..... N77-11066 #

IIEQ-75-22 ..... N77-11588 #
IIEQ-76-10 ..... N77-11583 #

IITRI-D6073-2-PT-1 ..... N77-11114*#
IITRI-D6073-3-PT-2 ..... N77-11115*#
IITRI-D6073-4 ..... N77-11116*#
IITRI-D6100-FR ..... N77-11124 #
IITRI-D6111 ..... N77-11126 #

ILL-PR-64 ..... N77-11466 #

IMM-411 ..... N77-11764 #

INIS-MF-1867 ..... N77-11565 #
INIS-MF-1868 ..... N77-11566 #

IS-M-63 ..... N77-11541 #

ISBN-0-309-0250-0 ..... N77-11932 #
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ISBN-0-309-03488-9 ..... N77-11925 #
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ISBN-92-835-0176-4 ..... N77-11221 #
ISBN-92-835-1211-1 ..... N77-11907 #
ISBN-92-835-1214-6 ..... N77-11070 #

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ISL-CO-212/75 ..... N77-11349 #
ISL-CO-215/75 ..... N77-11205 #
ISL-CO-217/75 ..... N77-11369 #

ISL-R-101/76 ..... N77-11376 #
ISL-R-109/75 ..... N77-11639 #
ISL-R-110/75 ..... N77-11012 #
ISL-R-112/75 ..... N77-11406 #
ISL-R-115/75 ..... N77-11640 #
ISL-R-116/75 ..... N77-11370 #
ISL-R-117/75 ..... N77-11371 #
ISL-R-120/75 ..... N77-11641 #
ISL-R-124/75 ..... N77-11372 #
ISL-R-127/75 ..... N77-11373 #
ISL-R-129/75 ..... N77-11374 #
ISL-R-135/75 ..... N77-11375 #

ISL-4/74 ..... N77-11819 #
ISL-35/74 ..... N77-11392 #
ISL-36/74 ..... N77-11368 #

ISR-2 ..... N77-11664 #

ISSN-0012-6160 ..... N77-11906 #
ISSN-0077-5541 ..... N77-10999 #

ITR-4 ..... N77-11184 #

IZF-1975-11 ..... N77-11668 #

JHPR-75-21 ..... N77-11477 #

JPL-TM-33-779 ..... N77-11197*#
JPL-TM-33-790 ..... N77-11198*#
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KNMI-102-95 ..... N77-11619 #

L-10408 ..... N77-11087*#
L-10525 ..... N77-11069*#
L-10619 ..... N77-11339*#
L-10681 ..... N77-11099*#
L-10750 ..... N77-11342*#
L-10789 ..... N77-11666*#
L-10832 ..... N77-11346*#
L-10878 ..... N77-11033*#
L-10923 ..... N77-11001*#
L-11011 ..... N77-10995*#

LA-UR-76-125 ..... N77-11694 #

LBF-FB-109/76 ..... N77-11445 #
LBF-FB-128/76 ..... N77-11446 #

LBF-TB-126/75 ..... N77-11447 #

LBL-4149 ..... N77-11203 #
LBL-4175 ..... N77-11157 #
LBL-4271 ..... N77-11909 #

LC-75-619305 ..... N77-11459 #
LC-76-18680 ..... N77-11560 #
LC-76-608159 ..... N77-11471 #

LEA-75-2 ..... N77-11200 #

LEC-8667 ..... N77-11505*#
LEC-9104A ..... N77-11091*#

LG75ER0054 ..... N77-11045 #
LG76ER0007 ..... N77-11017 #
LG76ER0095 ..... N77-11032*#

LL-152 ..... N77-11416 #

LMSC-HREC-TR-D496597 ..... N77-11002 #
LMSC-HREC-TR-D496946 ..... N77-11212*#
LMSC-HREC-TR-D568000 ..... N77-11092*#

LR-591 ..... N77-10999 #

LSI-ER-251-10-1 ..... N77-11672*#

M-188 ..... N77-11344*#
M-192 ..... N77-11570*#
M-195 ..... N77-11853*#

M-215 ..... N77-11622 #

MARMAP-CONTRIB-132 ..... N77-11497*#

MBL-1975-7 ..... N77-11724 #

MDC-A4434 ..... N77-11107*#

MDC-G6508-PT-1-VOL-1 ..... N77-11084*#
MDC-G6508-PT-1-VOL-2 ..... N77-11085*#
MDC-G6508-PT-1-VOL-3-BK-1 ..... N77-11083*#

MDC-J6902 ..... N77-11036 #

MLM-2291 ..... N77-11419 #

MRI-75-FR-1379 ..... N77-11384 #
MRI-75-FR-1395 ..... N77-11578 #

MS-R-7615 ..... N77-11467 #
MS-R-7616 ..... N77-11776 #

MSNW-75-131-2 ..... N77-11393 #

MTR-3122 ..... N77-11751 #
MTR-7170 ..... N77-11569*#

NADC-75251-20C ..... N77-11734 #
NADC-75368-30 ..... N77-11038 #
NADC-75369-30 ..... N77-11040 #
NADC-76049-30 ..... N77-11065 #
NADC-76078-30 ..... N77-11036 #
NADC-76085-40 ..... N77-11659 #
NADC-76110-40 ..... N77-11658 #
NADC-76115-30 ..... N77-11165 #

NAPTC-PE-71 ..... N77-11410 #

NASA-CASE-ARC-11036-1 ..... N77-11364*#
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NASA-CASE-LAR-11549-1 ..... N77-11397*

NASA-CASE-MFS-23447-1 ..... N77-11403*#
NASA-CASE-MFS-23564-1 ..... N77-11079*#

NASA-CASE-NPO-13759-1 ..... N77-11363*#
NASA-CASE-NPO-13763-1 ..... N77-11398*#
NASA-CASE-NPO-13886-1 ..... N77-11269*#

NASA-CR-2705 ..... N77-11006*#
NASA-CR-2716 ..... N77-11005*#
NASA-CR-2745 ..... N77-11034*#
NASA-CR-2746 ..... N77-11667*#
NASA-CR-2748 ..... N77-11345*#
NASA-CR-134827-VOL-1 ..... N77-11048*#
NASA-CR-134827-VOL-2 ..... N77-11049*#
NASA-CR-135068-VOL-1 ..... N77-11046*#
NASA-CR-135068-VOL-2 ..... N77-11047*#
NASA-CR-135085 ..... N77-11114*#
NASA-CR-135086 ..... N77-11115*#
NASA-CR-135087 ..... N77-11116*#
NASA-CR-135103 ..... N77-11154*#
NASA-CR-135109 ..... N77-11531*#
NASA-CR-137912 ..... N77-11340*#
NASA-CR-137919 ..... N77-11677*#
NASA-CR-137930 ..... N77-11672*#
NASA-CR-137934 ..... N77-11676*#
NASA-CR-137944 ..... N77-11054*#
NASA-CR-137959 ..... N77-11107*#
NASA-CR-137971 ..... N77-11064*#
NASA-CR-137974 ..... N77-11673*#
NASA-CR-144819 ..... N77-11086*#
NASA-CR-144970 ..... N77-11569*#
NASA-CR-145026 ..... N77-11030*#
NASA-CR-145043 ..... N77-11032*#
NASA-CR-145078 ..... N77-11211*#
NASA-CR-145087 ..... N77-11068*#
NASA-CR-145088 ..... N77-11440*#
NASA-CR-147645 ..... N77-11000*#
NASA-CR-147648 ..... N77-11090*#
NASA-CR-148976 ..... N77-11485*#
NASA-CR-148981 ..... N77-11486*#
NASA-CR-149093 ..... N77-11362*#
NASA-CR-149097 ..... N77-11494*#
NASA-CR-149102 ..... N77-11502*#
NASA-CR-149126 ..... N77-11354*#
NASA-CR-149127 ..... N77-11487*#
NASA-CR-149128 ..... N77-11488*#
NASA-CR-149129 ..... N77-11489*#
NASA-CR-149130 ..... N77-11490*#
NASA-CR-149131 ..... N77-11491*#
NASA-CR-149132 ..... N77-11492*#
NASA-CR-149133 ..... N77-11493*#
NASA-CR-149135 ..... N77-11495*#
NASA-CR-149136 ..... N77-11496*#
NASA-CR-149137 ..... N77-11497*#
NASA-CR-149138 ..... N77-11498*#
NASA-CR-149140 ..... N77-11499*#
NASA-CR-149145 ..... N77-11763*#
NASA-CR-149146 ..... N77-11198*#
NASA-CR-149148 ..... N77-11199*#
NASA-CR-149149 ..... N77-11197*#
NASA-CR-149150 ..... N77-11717*#
NASA-CR-149152 ..... N77-11500*#
NASA-CR-149153 ..... N77-11501*#
NASA-CR-149173 ..... N77-11955*#
NASA-CR-149174 ..... N77-11956*#
NASA-CR-149175 ..... N77-11948*#
NASA-CR-149176 ..... N77-11624*#
NASA-CR-149177 ..... N77-11138*#
NASA-CR-149182 ..... N77-11365*#
NASA-CR-149184 ..... N77-11267*#
NASA-CR-149188 ..... N77-11404*#
NASA-CR-149189 ..... N77-11503*#
NASA-CR-149190 ..... N77-11892*#
NASA-CR-149191 ..... N77-11508*#
NASA-CR-149192 ..... N77-11914*#
NASA-CR-149193 ..... N77-11367*#
NASA-CR-150046 ..... N77-11174*#
NASA-CR-150050 ..... N77-11081*#
NASA-CR-150051 ..... N77-11212*#
NASA-CR-150054 ..... N77-11092*#
NASA-CR-150055 ..... N77-11617*#
NASA-CR-150056 ..... N77-11003*#
NASA-CR-150058 ..... N77-11096*#
NASA-CR-150059 ..... N77-11755*#
NASA-CR-150061 ..... N77-11916*#
NASA-CR-150957 ..... N77-11532*#
NASA-CR-151007 ..... N77-11077*#
NASA-CR-151094 ..... N77-11078*#
NASA-CR-151097 ..... N77-11091*#
NASA-CR-151099 ..... N77-11505*#
NASA-CR-151101 ..... N77-11671*#
NASA-CR-151102 ..... N77-11084*#
NASA-CR-151103 ..... N77-11085*#
NASA-CR-151104 ..... N77-11083*#

NASA-TM-X-3417 ..... N77-10995*#
NASA-TM-X-3418 ..... N77-11069*#
NASA-TM-X-3421 ..... N77-11346*#
NASA-TM-X-3429 ..... N77-11155*#
NASA-TM-X-3441 ..... N77-11295*#
NASA-TM-X-3442 ..... N77-11007*#
NASA-TM-X-3443 ..... N77-11057*#
NASA-TM-X-3450 ..... N77-11570*#
NASA-TM-X-3451 ..... N77-11008*#
NASA-TM-X-3453 ..... N77-11908*#
NASA-TM-X-3454 ..... N77-11366*#
NASA-TM-X-3455 ..... N77-11268*#
NASA-TM-X-3457 ..... N77-11044*#
NASA-TM-X-58192 ..... N77-11675*#
NASA-TM-X-71210 ..... N77-11944*#
NASA-TM-X-71212 ..... N77-11613*#
NASA-TM-X-71213 ..... N77-11935*#
NASA-TM-X-71215 ..... N77-11945*#
NASA-TM-X-71217 ..... N77-11936*#
NASA-TM-X-71220 ..... N77-11618*#
NASA-TM-X-71221 ..... N77-11136*#
NASA-TM-X-71222 ..... N77-11635*#
NASA-TM-X-71223 ..... N77-11947*#
NASA-TM-X-71224 ..... N77-11965*#
NASA-TM-X-73144 ..... N77-11111*#
NASA-TM-X-73154 ..... N77-11063*#
NASA-TM-X-73171 ..... N77-11390*#
NASA-TM-X-73494 ..... N77-11439*#
NASA-TM-X-73497 ..... N77-11100*#
NASA-TM-X-73498 ..... N77-11529*#
NASA-TM-X-73512 ..... N77-11655*#
NASA-TM-X-73520 ..... N77-11530*#
NASA-TM-X-73521 ..... N77-11901*#
NASA-TM-X-73523 ..... N77-11101*#
NASA-TM-X-73526 ..... N77-11102*#
NASA-TM-X-73528 ..... N77-11718*#
NASA-TM-X-73529 ..... N77-11815*#
NASA-TM-X-73530 ..... N77-11103*#

NASA-TM-X-73533 ..... N77-11104*#
NASA-TM-X-73535 ..... N77-11053*#
NASA-TM-X-73538 ..... N77-11105*#
NASA-TM-X-73539 ..... N77-11817*#
NASA-TM-X-73540 ..... N77-11050*#
NASA-TM-X-73542 ..... N77-11051*#
NASA-TM-X-73544 ..... N77-11612*#
NASA-TM-X-73554 ..... N77-11106*#
NASA-TM-X-73556 ..... N77-11052*#
NASA-TM-X-73580 ..... N77-11389*#
NASA-TM-X-73936 ..... N77-11031*#
NASA-TM-X-73952 ..... N77-11266*#
NASA-TM-X-73973 ..... N77-11067*#
NASA-TM-X-73974 ..... N77-10998*#
NASA-TM-X-73985 ..... N77-11816*#
NASA-TM-X-74212 ..... N77-11481*#
NASA-TM-X-74213 ..... N77-11507*#
NASA-TM-X-74214 ..... N77-11521*#
NASA-TM-X-74215 ..... N77-11522*#
NASA-TM-X-74216 ..... N77-11523*#
NASA-TM-X-74217 ..... N77-11482*#
NASA-TM-X-74218 ..... N77-11504*#
NASA-TM-X-74219 ..... N77-11506*#
NASA-TM-X-74295 ..... N77-11055*#

NASA-TN-D-8195 ..... N77-11342*#
NASA-TN-D-8204 ..... N77-11118*#
NASA-TN-D-8266 ..... N77-11666*#
NASA-TN-D-8273 ..... N77-11087*#
NASA-TN-D-8283 ..... N77-11033*#
NASA-TN-D-8284 ..... N77-11001*#
NASA-TN-D-8291 ..... N77-11339*#
NASA-TN-D-8292 ..... N77-11099*#
NASA-TN-D-8302 ..... N77-11294*#
NASA-TN-D-8317 ..... N77-11400*#
NASA-TN-D-8331 ..... N77-11693*#
NASA-TN-D-8337 ..... N77-11213*#
NASA-TN-D-8339 ..... N77-11442*#
NASA-TN-D-8340 ..... N77-11004*#
NASA-TN-D-8341 ..... N77-11175*#
NASA-TN-D-8342 ..... N77-11056*#
NASA-TN-D-8343 ..... N77-11401*#
NASA-TN-D-8345 ..... N77-11402*#
NASA-TN-D-8347 ..... N77-11830*#
NASA-TN-D-8365 ..... N77-11674*#
NASA-TN-D-8366 ..... N77-11853*#
NASA-TN-D-8367 ..... N77-11343*#

NASA-TR-R-469 ..... N77-11344*#

NASA-TT-F-15497 ..... N77-11009*#
NASA-TT-F-16254 ..... N77-11075*#
NASA-TT-F-16734 ..... N77-11615*#
NASA-TT-F-16737 ..... N77-11616*#
NASA-TT-F-16740 ..... N77-11937*#
NASA-TT-F-17108 ..... N77-11614*#
NASA-TT-F-17111 ..... N77-11399*#
NASA-TT-F-17139 ..... N77-11528*#
NASA-TT-F-17187 ..... N77-10997*#
NASA-TT-F-17246 ..... N77-11117*#
NASA-TT-F-17248 ..... N77-11019*#
NASA-TT-F-17249 ..... N77-11946*#
NASA-TT-F-17262 ..... N77-11951*#
NASA-TT-F-17264 ..... N77-11785*#
NASA-TT-F-17265 ..... N77-11786*#
NASA-TT-F-17267 ..... N77-11954*#
NASA-TT-F-17273 ..... N77-11093*#
NASA-TT-F-17275 ..... N77-11670*#
NASA-TT-F-17278 ..... N77-11076*#
NASA-TT-P-17284 ..... N77-11029*#

NASC-0300-5-VOL-2 ..... N77-11161 #

NBS-BSS-73 ..... N77-11459 #
NBS-BSS-76 ..... N77-11471 #

NBS-SP-403 ..... N77-11560 #

NBS-TN-908 ..... N77-11747 #
NBS-TN-913 ..... N77-11381 #
NBS-TN-920 ..... N77-11726 #
NBS-TN-927 ..... N77-11367*#

NBS-7454 ..... N77-11379 #

NBSIR-75-927 ..... N77-11217 #
NBSIR-76-988 ..... N77-11214 #
NBSIR-76-1083 ..... N77-11216 #
NBSIR-76-1089 ..... N77-11379 #

NCSL-271-76 ..... N77-11660 #

NEPRF-TR-12-75(MII) ..... N77-11622 #

NERBC-PR-1 ..... N77-11600 #

NLR-AC-76-02 ..... N77-11352 #

NLR-MP-75012-U ..... N77-11746 #
NLR-MP-75016-U ..... N77-11348 #
NLR-MP-75036-U ..... N77-11071 #
NLR-MP-75038-U ..... N77-11072 #
NLR-MP-75041-U ..... N77-11020 #

NLR-TR-74012-U ..... N77-11450 #
NLR-TR-74159-U ..... N77-11010 #
NLR-TR-75043-U ..... N77-11097 #
NLR-TR-75050-U ..... N77-11450 #
NLR-TR-75076-U ..... N77-11011 #

NOAA-TM-NWS-TDL-59 ..... N77-11638 #

NOAA-76040903 ..... N77-11638 #

NPRDC-TR-76-33 ..... N77-11758 #

NPS-52ZW76031 ..... N77-11283 #
NPS-53ZH76047 ..... N77-11792 #
NPS-61SQFI76031 ..... N77-11637 #

NRC-15471 ..... N77-10999 #
NRC-1915032 ..... N77-11411 #

NRC/CORSPERS-76/1 ..... N77-11508*#

NRL-MR-3249 ..... N77-11748 #
NRL-MR-3259 ..... N77-11643 #
NRL-MR-3273 ..... N77-11736 #
NRL-MR-3280 ..... N77-11623 #

NRL-7970 ..... N77-11353 #
NRL-7973 ..... N77-11219 #
NRL-7994 ..... N77-11742 #

NR76H-1 ..... N77-11065 #

NSF-76-25 ..... N77-11279 #

NSF/DF-76-001A ..... N77-11544 #
NSF/ERG-76-4 ..... N77-11543 #
NSF/ERGSS-76-6 ..... N77-11556 #
NSF/GK-42132/SU-TR-200 ..... N77-11679 #
NSF/PRA-75-19-1 ..... N77-11926 #
NSF/RA-760102 ..... N77-11547 #
NSF/RA-760130 ..... N77-11545 #
NSF/RA-760156 ..... N77-11511 #
NSF/RA-760185 ..... N77-11544 #
NSF/RA/N-75-283 ..... N77-11577 #
NSF/RA/N-75-285 ..... N77-11548 #
NSF/RA/N-75-310 ..... N77-11551 #
NSF/RA/T-75-056 ..... N77-11215 #
NSF/RANN/SE/AER-74-17940-A01 ..... N77-11577 #
NSF/RANN/SE/GI-43895/PR-74-4 ..... N77-11551 #

NSRDC-4137 ..... N77-11735 #

NSWC/DL-TR-3442 ..... N77-11702 #
NSWC/WOL/TR-75-132 ..... N77-11385 #

NTISUB/B/138-76/008 ..... N77-11523*#

NUCLEAR-NOTES-1 ..... N77-11277 #

NUSC-TR-5327 ..... N77-11820 #

NYSERDA-75/02 ..... N77-11575 #

OAQPS-1.2-043 ..... N77-11606 #

ONR-CR215-229-2F ..... N77-11683 #
ONR-CR215-233-2 ..... N77-11017 #

ONRL-C-9-76 ..... N77-11142 #

ONRL-R-3-76 ..... N77-11663 #

ONRL/HUD/MIUS-29-ADD-2 ..... N77-11571 #

ORAU-126 ..... N77-11200 #

ORC-76-5 ..... N77-11741 #

ORNL-CSD-TM-1 ..... N77-11720 #

ORNL-CSD-2 ..... N77-11765 #

ORNL-TM-5283 ..... N77-11534 #

ORO-3443-59 ..... N77-11766 #

ORP/LV-76-7 ..... N77-11564 #

OSURF-4122-1 ..... N77-11548 #

OTR-76-87 ..... N77-11272 #
OTR-76-88 ..... N77-11276 #

OUEL-1142/76 ..... N77-11725 #
OUEL-1145/76 ..... N77-11756 #
OUEL-1146/76 ..... N77-11158 #

OWRT-A-041-MASS(4) ..... N77-11593 #
OWRT-A-052-NY(1) ..... N77-11921 #
OWRT-A-076-MICH(1) ..... N77-11510 #

OWRT-B-041-VA(7) ..... N77-11580 #
OWRT-B-074-NC(1) ..... N77-11387 #

PA-TR-2184 ..... N77-11181 #

PA-TR-2469 ..... N77-11206 #
PA-TR-4824 ..... N77-11179 #

PAS-75-50 ..... N77-11409 #

PB-245422/1 ..... N77-11557 #
PB-245423/9 ..... N77-11558 #
PB-245424/7 ..... N77-11559 #
PB-249881/4 ..... N77-11575 #
PB-250504/8 ..... N77-11542 #
PB-251235/8 ..... N77-11021 #
PB-252400/7 ..... N77-11378 #
PB-252416/3 ..... N77-11452 #
PB-252463/5 ..... N77-11543 #
PB-252798/4 ..... N77-11394 #
PB-252837/0 ..... N77-11548 #
PB-252887/5 ..... N77-11215 #
PB-252914/7 ..... N77-11926 #
PB-252920/4 ..... N77-11451 #
PB-252924/6 ..... N77-11577 #
PB-252927/9 ..... N77-11679 #
PB-253087/1 ..... N77-11642 #
PB-253092/1 ..... N77-11585 #
PB-253097/0 ..... N77-11556 #
PB-253099/6 ..... N77-11599 #
PB-253101/0 ..... N77-11931 #
PB-253576/3 ..... N77-11576 #
PB-253713/2 ..... N77-11475 #
PB-253936/9 ..... N77-11578 #
PB-253957/5 ..... N77-11580 #
PB-253962/5 ..... N77-11553 #
PB-253975/7 ..... N77-11279 #
PB-254166/2 ..... N77-11581 #
PB-254187/8 ..... N77-11273 #
PB-254195/1 ..... N77-11453 #
PB-254199/3 ..... N77-11579 #
PB-254366/8 ..... N77-11274 #
PB-254427/8 ..... N77-11607 #
PB-254469/0 ..... N77-11214 #
PB-254472/4 ..... N77-11272 #
PB-254475/7 ..... N77-11379 #
PB-254488/0 ..... N77-11271 #
PB-254503/6 ..... N77-11681 #
PB-254542/4 ..... N77-11510 #
PB-254615/8 ..... N77-11636 #
PB-254637/2 ..... N77-11547 #
PB-254683/6 ..... N77-11554 #
PB-254752/9 ..... N77-11922 #
PB-254754/5 ..... N77-11476 #
PB-254792/5 ..... N77-11466 #
PB-254795/8 ..... N77-11696 #
PB-254802/2 ..... N77-11924 #
PB-254806/3 ..... N77-11469 #
PB-254815/4 ..... N77-11468 #
PB-254819/6 ..... N77-11462 #
PB-254823/8 ..... N77-11380 #

PB-254834/5 ..... N77-11387 #
PB-254853/5 ..... N77-11598 #
PB-254878/2 ..... N77-11511 #
PB-254920/2 ..... N77-11903 #
PB-254925/1 ..... N77-11516 #
PB-254929/3 ..... N77-11477 #
PB-254961/6 ..... N77-11606 #
PB-254988/9 ..... N77-11923 #
PB-255012/7 ..... N77-11514 #
PB-255022/6 ..... N77-11593 #
PB-255054/9 ..... N77-11726 #
PB-255075/4 ..... N77-11459 #
PB-255092/9 ..... N77-11591 #
PB-255093/7 ..... N77-11384 #
PB-255095/2 ..... N77-11597 #
PB-255102/4 ..... N77-11169 #
PB-255103/4 ..... N77-11595 #
PB-255107/5 ..... N77-11584 #
PB-255117/4 ..... N77-11549 #
PB-255121/6 ..... N77-11454 #
PB-255171/1 ..... N77-11552 #
PB-255190/1 ..... N77-11168 #
PB-255203/2 ..... N77-11170 #
PB-255204/0 ..... N77-11382 #
PB-255209/9 ..... N77-11383 #
PB-255217/2 ..... N77-11928 #
PB-255227/1 ..... N77-11630 #
PB-255297/4 ..... N77-11596 #
PB-255313/9 ..... N77-11605 #
PB-255319/6 ..... N77-11509 #
PB-255320/4 ..... N77-11515 #
PB-255321/2 ..... N77-11555 #
PB-255349/3 ..... N77-11930 #
PB-255407/9 ..... N77-11590 #
PB-255408/7 ..... N77-11550 #
PB-255435/0 ..... N77-11386 #
PB-255436/8 ..... N77-11457 #
PB-255441/8 ..... N77-11167 #
PB-255455/8 ..... N77-11512 #
PB-255460/8 ..... N77-11592 #
PB-255476/4 ..... N77-11546 #
PB-255484/8 ..... N77-11276 #
PB-255488/9 ..... N77-11551 #
PB-255497/0 ..... N77-11518 #
PB-255502/7 ..... N77-11564 #
PB-255539/9 ..... N77-11381 #
PB-255541/5 ..... N77-11929 #
PB-255543/1 ..... N77-11545 #
PB-255549/8 ..... N77-11130 #
PB-255556/3 ..... N77-11589 #
PB-255584/5 ..... N77-11594 #
PB-255593/6 ..... N77-11586 #
PB-255594/4 ..... N77-11587 #
PB-255618/1 ..... N77-11747 #
PB-255637/1 ..... N77-11925 #
PB-255648/8 ..... N77-11921 #
PB-255686/8 ..... N77-11583 #
PB-255692/6 ..... N77-11470 #
PB-255695/9 ..... N77-11513 #
PB-255696/7 ..... N77-11561 #
PB-255697/5 ..... N77-11563 #
PB-255699/1 ..... N77-11588 #
PB-255714/8 ..... N77-11472 #
PB-255725/4 ..... N77-11906 #
PB-255803/9 ..... N77-11216 #
PB-255809/6 ..... N77-11217 #
PB-255813/8 ..... N77-11603 #
PB-255847/6 ..... N77-11473 #
PB-255857/5 ..... N77-11562 #
PB-255858/3 ..... N77-11574 #
PB-255864/1 ..... N77-11218 #
PB-255865/8 ..... N77-11886 #
PB-255878/1 ..... N77-11560 #
PB-255886/4 ..... N77-11601 #
PB-255890/6 ..... N77-11600 #
PB-255891/4 ..... N77-11739 #
PB-256045/6 ..... N77-11738 #
PB-256058/9 ..... N77-11737 #
PB-256082/9 ..... N77-11638 #
PB-256119/9 ..... N77-11932 #
PB-256293/2 ..... N77-11602 #
PB-256411/0 ..... N77-11933 #
PB-256425/0 ..... N77-11471 #
PB-256464/9 ..... N77-11604 #
PB-256635/4 ..... N77-11544 #

PIFR-689 ..... N77-11129 #

PR-255 ..... N77-11951*#

PR-256 ..... N77-11786*#
PR-257 ..... N77-11785*#
PR-263 ..... N77-11093*#

PRRL-75-CR-67 ..... N77-11858 #

PSI-TR-48-VOL-1 ..... N77-11854 #

PUB-62 ..... N77-11593 #

PWA-5379 ..... N77-11160 #
PWA-5441 ..... N77-11154*#

QPR-2 ..... N77-11499*#
QPR-3 ..... N77-11202 #
QPR-4 ..... N77-11511 #
QPR-6 ..... N77-11315 #

QR-1 ..... N77-11215 #
QR-2 ..... N77-11309 #
QR-3 ..... N77-11495*#
QR-3 ..... N77-11500*#

R-279 ..... N77-11451 #
R-701 ..... N77-11688 #
R-1840-PR ..... N77-11023 #
R-1863-ARPA ..... N77-11355 #
R-1870-NSF ..... N77-11926 #
R-2183 ..... N77-11141 #

RA-75-46C ..... N77-11516 #

RAD-TM-200-045-27 ..... N77-11574 #

RADC-TR-76-6 ..... N77-11308 #
RADC-TR-76-24 ..... N77-11699 #
RADC-TR-76-44-PT-2 ..... N77-11316 #
RADC-TR-76-50 ..... N77-11700 #
RADC-TR-76-58 ..... N77-11730 #
RADC-TR-76-63 ..... N77-11311 #
RADC-TR-76-68 ..... N77-11698 #
RADC-TR-76-77 ..... N77-11731 #
RADC-TR-76-78 ..... N77-11278 #
RADC-TR-76-79 ..... N77-11732 #
RADC-TR-76-91 ..... N77-11750 #
RADC-TR-76-93 ..... N77-11749 #
RADC-TR-76-100 ..... N77-11524 #
RADC-TR-76-107 ..... N77-11282 #

RCN-235 ..... N77-11885 #

RDR-1778-4 ..... N77-11184 #

RE-516 ..... N77-11416 #

REPT-1/1976 ..... N77-11347 #
REPT-2-53230/6R-51388 ..... N77-11673*#
REPT-6 ..... N77-11497*#
REPT-36.300 ..... N77-11345*#
REPT-75-11-03 ..... N77-11904 #
REPT-75-16 ..... N77-11732 #
REPT-75-0280A ..... N77-11024 #
REPT-75-0397 ..... N77-11172 #
REPT-76-SRC/6 ..... N77-11683 #
REPT-76-3 ..... N77-11768 #
REPT-76-02-04 ..... N77-11905 #
REPT-553 ..... N77-11500*#
REPT-0276-1211 ..... N77-11309 #
REPT-2288 ..... N77-11068*#
REPT-3233 ..... N77-11034*#
REPT-3656-2 ..... N77-11664 #
REPT-635182 ..... N77-11472 #

RIA-R-TR-76-013 ..... N77-11415 #

RR-23 ..... N77-11696 #
RR-75-1 ..... N77-11542 #
RR-76-3 ..... N77-11777 #
RR-76-4 ..... N77-11421 #
RR-76-5 ..... N77-11422 #
RR-385 ..... N77-11806 #
RR-391 ..... N77-11740 #

R76-11 ..... N77-11452 #

SAI/EF75-85 ..... N77-11578 #

SAM-REVIEW-7-75-VOL-3 ..... N77-11661 #

SAM-TR-76-3 ..... N77-11662 #

SAMSO-TR-76-58 ..... N77-11833 #
SAMSO-TR-76-72 ..... N77-11966 #
SAMSO-TR-76-78 ..... N77-11139 #
SAMSO-TR-76-94 ..... N77-11395 #
SAMSO-TR-76-110 ..... N77-11857 #

SAND-75-0545 ..... N77-11721 #
SAND-75-0626 ..... N77-11297 #
SAND-76-0009 ..... N77-11537 #

SAR-2 ..... N77-11393 #
SAR-3 ..... N77-11166 #

SCIENTIFIC-1 ..... N77-11621 #
SCIENTIFIC-2 ..... N77-11629 #

SC534.17FR-PT-2 ..... N77-11183 #

SEFC-CONTRIB-464 ..... N77-11497*#

SER-2-NO-60 ..... N77-11621 #
SER-427 ..... N77-11473 #

SERIAL-T-323 ..... N77-11798 #

SORI-EAS-76-091 ..... N77-11596 #
SORI-EAS-76-299 ..... N77-11597 #

SR-1 ..... N77-11628 #
SR-4 ..... N77-11858 #

SRI-3756-1 ..... N77-11730 #

SSS-75-264 ..... N77-11317 #

SU-IPR-648 ..... N77-11948*#
SU-IPR-655 ..... N77-11624*#
SU-IPR-661 ..... N77-11955*#
SU-IPR-662 ..... N77-11956*#

SU-SRI-3570-17 ..... N77-11602 #

SU-TM-72 ..... N77-11697 #

T(F)S/128 ..... N77-11407 #

TACOM-TR-12109 ..... N77-11416 #

TDCK-66739 ..... N77-11724 #
TDCK-66921 ..... N77-11668 #

TETRAT-A-412-75-011-APP-A ..... N77-11558 #
TETRAT-A-412-75-011-APP-B ..... N77-11559 #
TETRAT-A-412-75-011-F ..... N77-11557 #

TID-4581-R3 ..... N77-11695 #
TID-27003 ..... N77-11573 #

TM-230-1523 ..... N77-11003*#
TM-1976-13 ..... N77-11314 #

TR-2 ..... N77-11163 #
TR-2 ..... N77-11479 #
TR-2 ..... N77-11888 #
TR-3 ..... N77-11480 #
TR-3 ..... N77-11897 #
TR-4 ..... N77-11464 #
TR-4 ..... N77-11898 #
TR-5 ..... N77-11180 #
TR-5 ..... N77-11899 #
TR-13-ONR ..... N77-11789 #
TR-14-ONR ..... N77-11788 #
TR-16 ..... N77-11757 #
TR-34 ..... N77-11159 #
TR-35 ..... N77-11887 #
TR-58 ..... N77-11768 #
TR-75-12 ..... N77-11797 #
TR-75-16 ..... N77-11750 #
TR-77 ..... N77-11778 #
TR-97 ..... N77-11788 #
TR-97-SER-2 ..... N77-11770 #
TR-98 ..... N77-11789 #
TR-158 ..... N77-11727 #
TR-200 ..... N77-11679 #

TR-0076(6240-40)-4 ..... N77-11833 #
TR-0076(6260-20)-10 ..... N77-11966 #
TR-0076(6603)-9 ..... N77-11139 #
TR-0076(6605)-1 ..... N77-11395 #
TR-7115-4 ..... N77-11013 #
TR-22353-6001-RU-00 ..... N77-11531*#

TRB/NCHRP/REP-167 ..... N77-11932 #
TRB/SR-166 ..... N77-11475 #
TRB/TRR-574 ..... N77-11925 #

TRITA-EPP-75-19 ..... N77-11864 #
TRITA-EPP-76-02 ..... N77-11865 #

TRW-24916-6041-RU-00 ..... N77-11581 #

TTI-2-8-73-18-2 ..... N77-11476 #

T75-AU-7531U ..... N77-11821 #

UAH-RR-192 ..... N77-11617*#

UCID-17011 ..... N77-11572 #
UCID-17014 ..... N77-11722 #
UCID-17059 ..... N77-11767 #

UCLA-ENG-7612 ..... N77-11166 #
UCLA-ENG-7630 ..... N77-11755*#
UCLA-ENG-7631 ..... N77-11096*#
UCLA-ENG-76105 ..... N77-11365*#

UCRL-51738 ..... N77-11831 #

UDOT-MR-76-1 ..... N77-11462 #

UILU-ENG-75-2236 ..... N77-11688 #

UMTA-CA-11-0008-75-1 ..... N77-11696 #

UMTA-DC-06-0120-76-3 ..... N77-11931 #

UMTA-MA-11-0024-76-1 ..... N77-11922 #

UMTA-NY-11-0011-76-1 ..... N77-11929 #

UMTA-RDD-9-75-1 ..... N77-11930 #

UMTA-URT-3-75-6 ..... N77-11923 #

UNC-WRRI-76-113 ..... N77-11387 #

UNH-TR-ME-70(76)NASA-365-1 ..... N77-11340*#

URC-60801 ..... N77-11671*#
URC-60806 ..... N77-11676*#

US-PATENT-APPL-SN-537979 ..... N77-11397*
US-PATENT-APPL-SN-718266 ..... N77-11363*#
US-PATENT-APPL-SN-718268 ..... N77-11398*#
US-PATENT-APPL-SN-730045 ..... N77-11269*#
US-PATENT-APPL-SN-734902 ..... N77-11119*#
US-PATENT-APPL-SN-736909 ..... N77-11403*#
US-PATENT-APPL-SN-737974 ..... N77-11296*#
US-PATENT-APPL-SN-739908 ..... N77-11079*#
US-PATENT-APPL-SN-740457 ..... N77-11364*#

US-PATENT-CLASS-219-92 ..... N77-11397*
US-PATENT-CLASS-219-118 ..... N77-11397*

US-PATENT-3,988,561 ..... N77-11397*

USAAEFA-75-20 ..... N77-11039 #

USAAMRDL-TR-75-53 ..... N77-11041 #

USAAVSCOM-TR-76-27 ..... N77-11404*#

USAFA-TR-76-6 ..... N77-11896 #

USGS-WRD-WRI-76-045 ..... N77-11512 #

USGS-WRI-76-51 ..... N77-11512 #

UTAH-RR-500-925 ..... N77-11462 #

UTIAS-TN-202 ..... N77-11438 #

UTRC/R75-912046-4 ..... N77-11165 #

UWIS-DS-75-400 ..... N77-11794 #
UWIS-DS-75-428 ..... N77-11773 #

VI-231 ..... N77-11866 #

VIMS-SRAMSOE-93-REV ..... N77-11598 #

VPI-VWRRC-BULL-93 ..... N77-11580 #

VTH-212 ..... N77-11080 #

VTI-40 ..... N77-11917 #
VTI-41 ..... N77-11918 #
VTI-52 ..... N77-11919 #
VTI-55 ..... N77-11920 #

WAPD-TM-1206 ..... N77-11444 #

WES-MP-C-76-1 ..... N77-11455 #

WES-MP-S-76-2 ..... N77-11625 #

WES-TR-M-74-8-2 ..... N77-11519 #

WORKING-PAPER-5050-1-2 ..... N77-11931 #

WP-59-75-76 ..... N77-11806 #
WP-69-75-76 ..... N77-11740 #

WVT-TR-76009 ..... N77-11125 #

W76-08926 ..... N77-11580 #
W76-09758 ..... N77-11510 #
W76-09906 ..... N77-11387 #
W76-10131 ..... N77-11593 #
W76-10613 ..... N77-11921 #

X-661-76-217 ..... N77-11935*#
X-662-76-246 ..... N77-11965*#
X-671-76-237 ..... N77-11936*#
X-690-76-230 ..... N77-11945*#
X-691-76-40 ..... N77-11136*#
X-692-76-223 ..... N77-11944*#
X-692-76-244 ..... N77-11947*#
X-911-76-192 ..... N77-11613*#
X-912-76-239 ..... N77-11618*#
X-912-76-243 ..... N77-11635*#

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